Nova Scotia

Department of Agriculture and Marketing

1988 RESEARCH AND INNOVATIVE DEMONSTRATION REPORT

RESEARCH AND INNOVATIVE DEMONSTRATION COMMITTEE - 1988

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1988 Statistical Summary

Research Projects were funded from a number of sources. Some of these were at the discretion of the Committee while others were the result of individual initiative. A number of investigative projects are not included. The fund sources are as follows and may or may not be included in these statistics.

Source	Funds
N. S. Dept. of Agriculture and Marketing	215,291.
National Sciences and Engineering Research Council (NSERC)	192,443.
Atlantic Livestock Feed Initiative (ALFI)	453,086.
Canada-Nova Scotia Agri-Food Development Agreement (AFDA)	17,620.
Government and Industry Grants	140,974.
Government and Industry Contracts	278,018.
Agricultural Research Institute (ARI) Contracts	92,981.
Total all sources	$1,390,413.

1988 RESEARCH PROJECT REPORTS
(BY DEPARTMENTS)

Project Number	Project Leader	Project Title
Agricultural Engineering		
88-124	D. A. Allen	Poultry Ventilation
88-132	F. L. Desir	Safe Use of One-Tonne Fertilizer Bags
Animal Science		
88-16	M. L. Connor	Semen Processing and A.I. in Silver Fox
88-83	D. L. Patterson	Prediction of Carcass Fat in Broiler Chickens
88-84	D. M. Anderson	Wet Versus Dry Feeds For Foxes
88-92	D. M. Anderson	High Protein Feedstuffs for Monogastric Animals
88-103	A. Lirette	N.M.I. In The Study of Forage Structure
88-108	M. L. Connor	Assay For Melatonin
88-110	D. M. Anderson	Water Quality For Pigs
88-114	A. H. Fredeen	Mineral Metabolism in Ruminants
88-115	D. M. Anderson & C. Caldwell	Nutritional Evaluation of Nova Scotia Grown Triticale
88-122	T. Tennessen	Space Use By Stall Housed Calves
88-125	D. C. Crober	Evaluation of Broiler Strains
88-126	W. G. Mathewson	Lambs on Grass and Grain
88-130	M. L. Connor & D. M. Anderson	Herring For Growing Mink
88-131	D. M. Anderson	Crab Meal in Layer Hen Diets
88-135	D. L. Patterson	Swine Conformation and Relation to Carcass Composition
*	A. Lirette	Buoyancy Separation of Forage Particles and Their Use as a Concentrate Feedstuff

Biology

88-52	M. G. Sampson	Herbicide-Pathogen Interactions in Quackgrass
88-95	M. G. Sampson	Weed Control in Blueberries
88-119	A. B. Gray	Mycotoxins in Silage
88-128	M. G. Sampson	Mycoherbicides
88-134	J.-P. R. LeBlanc	A Management System for N.S.A.C. Entomological Collections

Chemistry-Soils

88-94	J. Hoyle	Translocation of Fungicides
88-97	K. S. MacLean & A. R. Robinson	Selenium Content of Sheep Blood
88-116	P. Warman	The Use Of Immobilized Enzymes in Soil Organic Matter Research
88-118	G. R. Brewster	Sediment Clogging in Nova Scotia Drainage Tiles
88-121	A. R. Robinson	Analysis of Meat and Meat Products by HPLC
88-129	A. R. Robinson	The Effect of Dietary Omega-3 Fatty Acids in Laying Hens

Economics and Business

88-93	K. G. Grant	Price Determination in Maritime Cattle Market

Livestock Services

88-105	H. Jansen	Effect of Breeding System on Reproductive Performance of Broiler Breeders

Plant Science

88-06	J. S. Bubar	Cereal and Protein Crops
88-07	J. S. Bubar	Forage Crops
88-24	T. H. Haliburton	Vegetable Variety/Management Trials
88-30	H.-Y. Ju	American Ginseng Production in N. S.
88-46	R. W. Daniels	Turfgrass Evaluation and Management
88-96	J. Nowak	Somatic Embryogenesis in Red Clover
88-98	D. Midmore	Propagation and Screening of Non-traditional Sources of Stress Tolerance in *Solanum* species
88-113	C. D. Caldwell	Artificial Dwarfing of 'Trillium' triticale
88-120	L. Mapplebeck	Greenhouse Crops - New Crops, New Cultivars, and New Practices
88-123	J. Nowak	Hydroxyproline Resistance, a Selection Method for Developing Winter Hardy Alfalfa
88-127	H.-Y. Ju	Effect of Plant Growth Regulators on Fruit Set and Yield on Lowbush Blueberry

Soils and Crops Branch

88-09	D. Mellish	Cereal Rate of Seeding Trial
88-111	D. Doohan	The Biology and Control of Coltsfoot
88-117	R. Gordon	Boundary Layer Microclimate as Affected by Plastic Tunnels

* Designates the report appears at the end of the regularly numbered reports.

Project 88-06

TITLE: Cereal and Protein Crops

LEADER: J. S. Bubar

OBJECTIVE: To support the breeding programs aimed at developing grain crops for the Atlantic region. To evaluate cultivars for recommendation and licensing. To support other research and development projects by carrying out other small plot trials that are requested by Atlantic Advisory Committee members.

PROGRESS: Details on individual trials appear in the regional data compilations.

The 1988 trials conducted under this grant were completed satisfactorily and data was submitted for statistical analysis with few complaints about missed deadlines. We felt lucky to get the harvest off with the difficult weather during harvest. Good co-operation among those who use our facilities and the mechanization that we now have was a key factor in our not losing more materials. The one trial that was damaged, "The Maritime Co-op Spring Wheat Trial" as a result of birds from the nearby corn, gave some yield data from three replicates although some reliability was lost. We included the winter wheat harvest in this project, which was established using other funds during the previous year.

Specific trials supported by this operating grant were as follows:

1. **Eastern Co-op 2-row barley trial**

   We had the highest average yield among the 4 Maritime sites and only New Liskeard had higher yields among the 16 sites at which this trial was conducted. Two of the third year entries and four of the second year entries performed considerably better than our checks, which makes them promising candidates for registration in the next year or two.

2. **Eastern Co-op 6-row barley trial**

   Our yields were average for the Maritime-Quebec region. Although there are not as many second or third year entries that appear superior to currently registered cultivars as with the two-row cultivars under our conditions, some that will be registered for use in Ontario and Quebec may also be satisfactory here.

3. **Maritime Co-op 2-row barley**

   This trial is mainly Charlottetown breeding lines, some of which are promising for entry into the Eastern Co-op trials.

4. **Maritime Co-op 6-row barley**

This trial included entries from a number of breeders in which we are seeking promising lines adopted to Maritime conditions. Barley yellow dwarf virus was severe on some entries, particularly the hull-less entries from China.

5. **Eastern Co-op oat test**

We had satisfactory average yields, as did some of the northern locations (Grand Falls, Normandin, Kapuskasing and New Liskeard). Otherwise oats performed poorly as most trial sites. The hull-less entries are considerably below the standard ones in groat yields.

6. **Maritime Co-op spring wheat screening test**

Our yields recorded were down and our C.V. was high due to bird damage. We wonder if the data is biased against awnless entries. However we do not note any serious differences in ranking between entries in our trial and at other locations and are pleased our data was accepted to contribute to the station-years of data required for registration.

7. **Short season soybean trial**

This trial looked satisfactory during the growing season but the results reported by the co-ordinator, who analyzed the data, suggest more variability and lower yeilds than we anticipated. These are being checked.

8. **Maritime winter wheat test**

This includes some winter triticale and was conducted under two management levels. Our yields were comparable to other sites under each management. The winter triticale entries look promising under both managements.

Dr. B. Gray monitored diseases in these trials throughout the summer. He observed less difference between entries in our trials in disease infections than in other trials he observed.

TITLE: Forage Crops

LEADER: J. S. Bubar

OBJECTIVE: Evaluation for cultivar registration and recommendation and for development of breeding materials as required for co-operative evaluation and breeding projects co-ordinated by the Forage Evaluators sub-committee and by the N-E.144 project.

PROGRESS: Details on individual trials are being combined with those from other co-operators and will appear in the 1988 Forage Evaluators report. Numbers of trials are down due to lack of material becoming available. This is a result of uncertainty about the Agriculture Canada breeding programmes and how the private breeders are going to serve our region. We expect this to increase markedly as our new co-ordinated efforts, which include participation in the N.E.-144 project, become more active.

Alfalfa: The trial seeded in 1986 will be plowed up after winter survival data is collected in the spring of 1989. Entries in this trial lack verticillum wilt resistance so none would now be considered suitable for registration. There was little difference among entries in the absence of the verticillum wilt disease.

Trials seeded in 1987 and 1988 will be continued since they include some entries with moderate resistance to verticillum. These trials will be a source of superior material to which verticillum wilt resistance may be added.

Timothy: Although we have good, clear-cut results from our trial, it is dissappointing that all of the superior entries are already recommended and being grown on our farms. This is a further evidence that the forage breeding effort has fallen behind.

Ryegrasses and fescues: Ryegrass x fescue hybrids continue to produce high yields of high quality forage. Norlea perennial ryegrass has retained a good stand and is among the high yielding entries. Although it lacks quality and is susceptible to diseases that make it an unlikely candidate for recommendation, it does provide evidence that we should evaluate more of the newer cultivars of this grass.

New trials established in 1988: These include a birdsfoot trefoil trial to evaluate material out of the N.E.-144 project that is expected to compete better in mixtures, a trial incorporating red clover breeding lines out of the Charlottetown program and several regional trials.

TITLE: CEREAL RATE OF SEEDING

LEADER: Dwane Mellish

OBJECTIVE: To evaluate the response of six grain types to a range of seeding rates while controlling disease and lodging pressure.

PROGRESS: The project was conducted over three years using winter wheat, 2 and 6 row barley, spring wheat, spring triticale and hulless oats. Due to poor winter survival only two year's data is available for winter wheat and hulless oats was added to the project in the second year. All species were seeded at rates of 100,200.... 600 seeds/m^2 based on the kernel weight of the seed.

The winter wheat was grown in 1987 and 1988; 1987 being a very dry year and 1988 being a very wet year. Due to these weather conditions the results in the two years were very different.

In both years the varieties Monopol and Borden consistently outyielded the variety, vuka, mostly due to winter survival. Beyond a seeding rate of 300 seeds/m no yield increase was found. These trials were all seeded at a row spacing of 15 cm. Seeding rate may have additional influence if a narrower row spacing was utilized.

The spring cereal component of this project was conducted over a three year period. Excessively heavy rains in 1988 resulted in uncontrolled disease pressure as well as extensive lodging in the barley. Neither of these were adequately controlled in 1988 by the management practices utilized.

The trial concluded that the Leger (6-row barley) and the Beaguelita (triticale) do not show a significant yield response beyond a seeding rate of 300 seeds/m^2. The Rodeo (2-row barley) and the MAX (spring wheat) gave a yield response up to a seeding rate of 400 seeds/m^2.

These trials were also conducted on a row spacing of 15 cm and may not indicate the response at a narrower row spacing (10 cm) which is now becoming popular. Further evaluation of the influence of row spacing and seeding rate on cereal performance is being carried on.

Project 88-16

TITLE: Semen Processing and A.I. in Silver Fox

LEADER: M. L. Connor

OBJECTIVE: To investigate and evaluate methods of semen processing for freezing silver fox semen.

PROGRESS: In previous years comparisons were made of semen extenders, of variation in semen production by male foxes throughout the breeding season and of freezability and post-thaw viability of fox sperm. This past season was to be used to refine the freezing/thawing techniques for fox semen and optimize post-thaw fertility.

Earlier progress was made with extender evaluation in that the egg-yolk-tris extender recommended by some laboratories was not satisfactory for silver fox semen frozen by non-automated freezing as practiced locally. Best results were achieved by a slightly modified Fresh Plus extender (egg yolk citrate). Post-thaw motility, as evaluated at intervals from one week to ten months after freezing in the 1988 season, ranged from 10% to 50% for the egg-yolk-tris extender and from 30% to 80% with the Fresh Plus (modified) extender. Consistently more samples had > 70% motility with the Fresh Plus extender. As previously noted, individual animal variation as well as time of the season affected freezability or post-thaw motility. N.S.A.C. herd size and other commitments of animals did not allow insemination with frozen semen in 1988. In the 1989 breeding season, due to relocation of the project leader, no semen freezing nor A.I. with frozen semen was conducted under this project.

TITLE: Vegetable Variety/Management Trials

LEADER: T. H. Haliburton

OBJECTIVE:

1. To determine the performance of new "super-sweet" hybrid cultivars of sweet corn under various management systems such as pre-sprouting and the use of plastics.

2. To further observe the cultivar/planting date/interaction of the oriental vegetables: Chinese cabbage, winter radish.

3. To observe the performance of promising new head lettuce cvs under local conditions.

4. To determine if multi-transplant units are practical with sweet Spanish onion cultivars.

PROGRESS:

Ten hybrid cultivars of daikon (long oriental winter radish) and seventeen Chinese cabbage were planted in a randomized complete block design trials in the Boulden Field, N.S.A.C. They were planted May 24 and May 25, 1988 respectively. Standard cultural and pest control practices were followed. Records of yield, flower stock development, maturity, individual size and shape were recorded. Cultivars were ranked according to their desirability for commercial production in this region. Results were presented at the Memramcook Atlantic Vegetable Committee meetings, and are being published in the Plant Science Department Annual Report.

An observation trial using a plastic field cover or floating mulch, was demonstrated on super sweet sweet corn, daikon and Chinese cabbage hybrid cultivars. The effects were very promising. Growth of all corn cvs was enhanced, advancing harvest date on all 8 cvs tried. Bolting of the crucifers was reduced by the plastic and there was a cv x plastic interaction. These effects will be studied more fully in 1989.

TITLE: American Ginseng (Panax quinquefolium L.) Trial

LEADER: H.-Y. Ju

OBJECTIVE:
1. To evaluate the UV-treated woven black polypropylene as shading material
2. To evaluate sawdust as mulching material

PROGRESS: Two units (24 x 24) of ginseng structure were added to the Plumdale plot. Woven cloth was much easier to set up to cover the ginseng plantings. No different effect was found in the comparison between woven cloth and the wooden lath but the woven cloth cover was removed prior to winter conditions to avoid any damage from snow loading on top of the shading.

Sawdust mulching gave better results on sprouting in the spring and overall growth of ginseng compared to barley straw mulching.

There were no diseases during the summer which may be due to the alternate spray of Rovral and Dyrene fungicides. However nutrient deficient symptoms were noted in the form of veinal chlorosis. Magnesium or micronutrient deficiencies may be the cause. Soil and foliar tissues will be tested to identify the deficient symptom and to correct the problem in the following spring.

TITLE: Turfgrass cultivar and mixture evaluation. Development of management programs for optimum turfgrass growth.

LEADER: R. W. Daniels

OBJECTIVE: Evaluation of turfgrass cultivars, both as pure lines and in mixtures for their overall performance. Promising new cultivars are evaluated with standard, recognized cultivars of a particular species. Standards for evaluation are those which are recognized by all turf researchers throughout Canada. Information from their performance may therefore be useful in licensing new cultivars in Canada. This programme is expanded to include high quality turfgrass mixtures, and overwintering ability of certain cultivars.

Using established turfgrass and by re-establishing new plots as required, evaluate and demonstrate (at field days, etc.) latest technology in turfgrass culture and management. Exploratory areas are in proper seeding and maintenance of turf.

Sod production in Nova Scotia presently exceeds 2,000 acres. Industry is self sufficient with no imports from outside region. Value of sod sold in excess of 2.0 million dollars per year.

With some 2,000 turfgrass areas (baseball, softball, athletic fields, golf courses, playgrounds, parks and lawn bowling areas in Nova Scotia), in addition to the homeowners, there is a very real need for proper management of turfgrass for specific area and uses.

PROGRESS:

Effect of Seed Mixture and Seeding Rates on Plant Establishment

Perennial ryegrass (Lolium perenne L.) and Kentucky bluegrass (Poa pratensis L.) seed mixtures were field established to determine the optimum percent of each species in the mixture. Two seeding rates of 1.25 kg/100 m^2 and 1.75 kg/100 m^2 were tested. Perennial ryegrass was added to the mixtures in increments of 5% for a range of 5 to 30% of the mixture. All other seed consisted of Kentucky bluegrass.

Results indicate that for summer turf establishment both seeding rates resulted in an adequate turf population. The optimum percent of perennial ryegrass in the Kentucky bluegrass-perennial ryegrass mixture was 10%. Larger percentages of perennial ryegrass resulted in decreasing the content of Kentcuky bluegrass (the more desirable species).

Evaluation of Established Herbicides in Turf

Various rates and combinations of recommended herbicides were evaluated as to their effectiveness in providing adequate weed control in established turfgrass. All herbicide combinations except MCPA and mecoprop gave an acceptable level of weed kill. Best results were obtained from treatments containing a combination of 2,4D, mecoprop and dicamba.

Non-Phenoxy Herbicides in Turf

Non-phenoxy (2,4-D) compounds were evaluated for their effectiveness in weed control in established turfgrass. Treatments included both added and non-added fertilizers. Non-phenoxy treatments resulted in superior weed control than phenoxy treated plots,. No additional benefit was obtained by applying high nitrogen fertilizer with the herbicide. This is most likely due to the relatively high level of nitrogen applied propre to the herbicide treatment.

Project 88-52

TITLE: Herbicide-pathogens interactions in quackgrass

LEADER: M. G. Sampson

OBJECTIVE:

(a) To verify a technique involving slab gel electrophoresis and serological techniques for easy identification of intraspecific variation in clones of quackgrass collected from the field. This will be used to verify results obrtained from herbicide tolerance trials established in the field.

(b) To evaluate the potential of three fungal pathogens, used alone and in combination with herbicides, on the control of quackgrass and the effect of these pathogens on the efficacy of conventional herbicides. This will provide data required to obtain patents on three potential mycoherbicides for control of quackgrass.

(c) To isolate and test phytotoxins produced by pathogens from quackgrass for their potential as mycoherbicides.

PROGRESS:

Agropyron repens (L.) Beauv. (quackgrass) has been designated by the Canada Expert Committee on weeds as one of the most serious weed threats to Canadian Agriculture. Chemicals are the main method of control and most research currently being conducted is directed at chemical control. The weed, however, still continues to cause serious problems due th uneconomical control strategies and a lack of knowledge of the biology of the weed.

Previous research conducted by the applicant has demonstrated intraspecific variation in herbicide response between clones of quackgrass. This would be one possible expansion for inadequate control of quackgrass in some situations. This work also demonstrated that diseases on quackgrass could interfere with herbicide absorption, further reducting their efficacy. During the course of this and previous research, it was noted that, in the absence of herbicides, some fungal pathogens involved have the characteristics of fungi that are currently used as mycoherbicides, which represents the latest advance in biotechnology in weed control. The development of these pathogens involves the issue of a patent and commercial development of the product. Identification of these pathogens cannot be publicized due to patent requirements.

Procedures:

(a) Intraspecific variation:

Electrophoresis studies were directed at separating quackgrass protein by slab gel electrophoresis. This would indicate the genetic variation present within each enzyme which could be responsible for the tolerance. Any clone collected from the field could be subjected to this test and tolerant clones identified by the presence of the unique band.

The methodology for performing the electrophoresis is still being worked out. The technique for extracting proteins from rhizome and leaf tissue has been refined, but protein separation is still not as good as expected. These problems still have to be resolved. Despite these problems, there appears to be an extra protein band in those clones that have shown tolerance to the herbicide glyphosate. This must be investigated further.

(b) Control of quackgrass by fungi and their interaction with herbicides

Four pathogens were isolated and identified as occurring on quackgrass. One attacks the rhizomes and reduces rhizome production to zero. The other two pathogens are leaf spotting pathogens and one affects the inflorescence. The best media for growth of these fungi has been identified as well as spore concentrations which are required for infection. Two of the fungi are host specific. The presence of leaf spots on the leaves may interfere with the absorption and/or translocation of the herbicide glyphosate. This will reduce control.

Two pathogens on quackgrass were shown to produce a phytotoxin which will desicate the plant. If this toxin is host specific, then it has potential for use in a control programme. In addition, an isolate of one of these organisms from barley also produced a toxin. There were varietal differences in barley varieties as well as quackgrass in response to this toxin.

(c) Plans for 1989

Work in 1989 will continue to solve problems with the electrophoresis techniques encountered in 1988. As well, studies to identify herbicide tolerant clones will continue. Studies will also continue to evaluate the potential of those pathogens isolated in 1988 as mycoherbicides. This will involve more culture studies as well as inoculation studies on quackgrass and other plant species. The isolation of a damaging toxin would be a major breakthrough in the study of pathogen interactions on quackgrass and provide a compound to work with as a control measure. Studies will continue on isolating this toxin from culture of the fungi and testing its specificity on various plant species.

Project 88-83

TITLE: Prediction of Carcass Fat in Broiler Chickens

LEADER: D. L. Patterson

OBJECTIVES:

1. to determine the level of carcass fat in male and female broiler chickens of two strains
2. to establish the value of plasma VLDL measurements in predicting carcass fat

PROGRESS:

It is possible to select for decreased levels of carcass fat in broiler chickens, but to do this effectively a measurement on the live bird is desirable. Plasma very low density lipoprotein levels (VLDL) have potential in predicting carcass fat levels. This project was thus carried out to determine the value of VLDL as a predictor over a range of ages and for two different types of birds.

Three hundred and twenty chickens of two stocks, a commercial (Arbor Acres x Arbor Acres) and a purebred White Rock stock, were raised under typical commercial management conditions. Birds were weighed and measured at weekly intervals and 20 males and 20 females of each stock slaughtered each week from four to seven weeks of age. A blood sample was collected from each bird prior to slaughter.

Growth rate of the White Rock stock was significantly less than that of the commercial stock (717 g live weight for males at 7 weeks of age versus 1883 g). Abdominal fat pad as a percentage of carcass weight was also less for White Rocks at all ages (0.9% versus 3.0% for males at four weeks of age, 3.0% and 4.0% for males at seven weeks). Percent carcass fat determined by ether extraction showed the same pattern, with four week old White Rock males having 26.2% fat (dry matter basis) versus commercial males with 40.6%. Values at seven weeks were 31.8% and 43.1%. Female bird values were slightly higher than those of males, but a similar trend occurred.

The correlation of plasma VLDL level with abdominal fat as a percent of carcass weight was 0.43 across all age-sex-stock groups. However on a within group basis the correlations were generally not significantly different from zero. The overall correlation of plasma VLDL with percent carcass fat was 0.32, but again correlations were usually not significant on a within group basis. It appears that if blood plasma VLDL is to be used to predict carcass fatness in broiler chickens that prediction equations would have to be developed for each stock of birds, and may not be accurate in many cases.

Project 88-84

TITLE: Wet versus dry feeds for foxes (Lactation supplements and weaning diets)

LEADER: D. M. Anderson

OBJECTIVE: To examine the performance of foxes weaned at 42 days and evaluate the 3 dietary programs fed through to the grower stage (10 wks).

PROGRESS:

A total of 104 fox pups were weighed and randomly assigned to one of three diets after weaning (6 wks). Feed consumption was recorded on a daily basis throughout the study and pups were weighed again at 7 weeks and at the end of the weaner period (10 wks).

All three diets were formulated to meet the requirements of fox pups at this stage of development and were fed on a 40% dry matter basis. Diet 1 was formulated using wet feed products; diet 2 was a homemade dry type diet mixed with water and fed as a wet gruel; diet 3 was a commercial puppy feed (Purina Puppy Chow) soaked in water.

6-7 wks

Animals on diets 1 and 2 showed similar gains in weight which were significantly greater than those fed the puppy chow. Animals fed the wet type diet (diet 1) consumed significantly less in the 6-7 wk period than either of the two other diets. No significant difference was found to exist between consumption of diet 2 and consumption of diet 3.

7-10 wks

Consumption of diet 1 continued to be significantly less than that of diets 2 and 3 with no difference existing between 2 and 3. Weight gains were found to be similar for the wet diet, dry diet and commercial diet.

Although diets 1 and 2 showed similar weight gains and different consumptions, feed:gain ratios were similar. Significantly different feed:gain ratios were found to exist between diets 1 and 3, and diets 2 and 3 over the 7 to 10 week period. The commercial diet showed the poorest feed to gain ratio compared to either the wet or dry homemade diets.

Table 1 Post weaning performance of fox puppies 6-7 weeks

	Diet 1-FFW1, wet ingredients	Diet 2-FFW2, dry ingredients	Diet 3-commercial feed
Feed Consumption (kg) as fed (40% DM)	1.215[b]	1.414[a]	1.346[a]
Gain in Weight (kg)	.236[a]	.216[a]	.158[b]
Feed/Gain	4.97	6.55	8.51

Table 2 Post weaning performance of fox puppies 7-10 weeks

	Diet 1-FFW1, wet ingredients	Diet 2-FFW2, dry ingredients	Diet 3-commercial feed
Feed Consumption (kg) as fed (40% DM)	6.483[b]	7.766[a]	7.615[a]
Gain in Weight (kg)	.980	1.041	1.003
Feed/Gain	6.70[a]	7.45[a]	7.73[b]

TITLE: High Protein Feedstuffs for Monogastric Animals

LEADER: D. M. Anderson

OBJECTIVE: To assess the protein value of poultry by-product and crab meal by *in vitro* and *in vivo* procedures.

PROGRESS:

A. Growth Trials

Feed consumption and weight gain were determined by feeding rats diets that contained poultry by-product meal (PBM) or crab meal (CM).

1. Poultry By-product meal:

Three-week old, male, Sprague-Dawley, rats each weighing approximately 50 grams were housed individually in stainless steel wire mesh cages equipped with a water spigot and a feed dish. Twelve samples of poultry by-product meal were compared as protein sources in diets formulated to contain 10% crude protein. A control diet incorporated casein as a protein source. Nine rats was randomly assigned to each diet. Rat weights were recorded initially then weekly for the 3 weeks of the trial period. Feed intake, total weight gain, protein efficiency ratio and feed to gain were calculated for the 3 week trial period.

2. Crab meal:

Three-week old, male, Sprague-Dawley, rats initially weighing 50g were housed individually in stainless steel wire mesh cages equipped with a water spigot and feed dish that allowed ad libitum supply of both feed and water. Eleven rats were randomly assigned to each of a control diet (casein) or 10 diets containing different samples of crab meal. Similar procedures were used as described for the poultry by-product test.

Growth Trial Results

Significant difference in weight gain occurred among the PBM samples (table 1). Feed consumption, feed to gain and PER were similar among diets. Protein quality of the PBM was high and relatively consistant.

For the crab meal samples, the variable nature of the meal was indicated by the difference in growth rate by rats fed the meal. Consumption of the diets with crab meal were variable. PER was extremely poor on all the CM samples. The reduction in protein quality and variable nature of the protein quality is probably due to the relative quantities of

shell present. The reduction in feed intake is perhaps related to particle size of the crab meal. Where large sized particles were observed in the sample there was a tendency for reduced feed intake.

B. Vitro versus in vivo protein digestibility.

In vivo digestibility of CM and PBM were determined by housing male Sprague-Dawley rats (375g) in Nalgene metabolic cages. Digestibility was calculated by difference when a basal diet was replaced by the test ingredient at 10 to 20% of the diet.

In vitro protein digestibility was determined using a digestion procedure in which pepsin was used to hydrolyse the protein in the feedstuff.

Correlation between in vitro and in vivo digestibility of protein in PBM was significant and high $r = 0.90$. The same correlation for crab meal was lower ($r=0.28$). In vitro protein digestion using pepsin was an effective predictor of use of the protein by rats for the PBM but not for the CM.

Table 1 Growth Performance By Rats Fed Poultry By-product Meal (PBM) or Crab Meal (CM) as a Protein Feed.

Poultry by-product meal

Sample #	Feed Consumption (g)	Weight Gain (g)	Feed/ Gain	Protein efficiency Ratio (PER)
1	247.4	36.5^{abcd}	6.76^{ab}	1.50^{c}
2	263.0	43.9^{ab}	5.10^{b}	1.67
3	239.3	37.2^{abcd}	6.40^{ab}	1.58
4	242.6	36.0^{bcd}	6.84^{ab}	1.49
5	246.8	33.0^{cd}	7.53^{ab}	1.34
6	246.8	31.0^{d}	8.46^{a}	1.31
7	243.4	37.2^{abcd}	6.91^{ab}	1.32
8	255.1	40.7^{abc}	6.35^{ab}	1.60
9	263.3	44.4^{ab}	5.99^{b}	1.70
10	240.8	40.1^{abcd}	5.04^{b}	1.66
11	258.8	43.4^{ab}	6.00^{b}	1.68
12	265.0	45.5^{a}	5.85^{b}	1.72

Crab meal

Sample #	Feed Consumption (g)	Weight Gain (g)	Feed/ Gain	Protein efficiency Ratio (PER)
1	307.5^{bc}	11.5^{cde}	38.2^{c}	0.35^{bc}
2	275.1^{bcd}	10.6^{cde}	63.1	0.39^{bc}
3	301.4^{bc}	6.5^{de}	24.0	0.22^{cd}
4	242.8^{d}	-2.7^{e}	38.2	-1.12^{d}
5	373.1^{a}	40.3^{a}	85.9	1.06^{a}
6	276.8^{bcd}	15.5^{bcd}	-4.0	0.45^{bc}
7	322.1^{b}	26.4^{b}	3.63	0.77^{ab}
8	301.5^{bc}	24.3^{bc}	29.3	0.79^{ab}
9	283.8^{bcd}	13.2^{bcd}	28.4	0.48^{bc}
10	253.1^{cd}	5.9^{de}	10.6	0.22^{cd}

Note: Means for PBM and CM with the same letter in the same column are not significantly different ($P>0.05$)

Project 88-93

TITLE: Price determination in Maritime cattle market

LEADER: K. Gary Grant

OBJECTIVE: To explain price determination in the market for cattle raised and sold for slaughter in the Maritimes.

PROGRESS: The data have been extended to include the retail level as well as the primary wholesale levels.

In the study of relationships between or among time-series (eg., the relationship between Alberta carcass prices and Atlantic region carcass prices) the true relation may be masked by autocorrelation. Consequently, ARIMA (autoregressive, integrated, moving-average) models are fitted to the individual time-series. (For example, the ARIMA model fitted to weekly Truro D1, 2 cow prices over Jan., 1980 to June, 1988 is ARIMA $(0,1,1)\ (0,1,1)^{52}$ - a process involving a nonseasonal aspect with a moving-average process of order one and a seasonal aspect with another moving-average process of order one in first-differenced data separated by one year.)

The study proceeds by examining relations between and among the residuals arising from the ARIMA models fitted to each time-series. This will lead to answers to questions such as, How accurately are short-term movements in Truro cattle prices predicted by movements in Toronto cattle prices? and What is the importance of local cattle supplies relative to Toronto and Alberta carcass prices in the determination of local (Atlantic region) carcass prices?

Project 88-94

TITLE: Translocation of Fungicides

LEADER: J. Hoyle

OBJECTIVE: To investigate the behavior of fungicides used as seed treatments in peas, beans and corn and to develop a new method for the analysis of the fungicides Thiram and Captan from plant sources.

PROGRESS:

The second, and final year of this project, again involved field plots with several varieties of peas, beans and corn being grown. Samples of soil and plant material were taken during the growing season. Due to the extremely damp weather some trials were not successful, however it was clearly demonstrated that the treated seeds showed a germination rate in excess of 300% that of the untreated seed for all varieties under study. Once again, analysis of the harvested produce showed no evidence of fungicides of their decomposition products. However, samples of young plants showed evidence of both Captan and Thiram which may be a significant factor in the translocation of these compounds into the animal population. Soil samples showed low levels of fungicide residues for about 6 weeks after planting and also showed that the residue concentration decreases with distance away from the seeds in the soil. There was some evidence of decomposition products of these compounds in the soil for longer periods after planting.

The results of this study clearly indicate that there was no detectable residue of the seed treatments either in the produce or in the soil after the season was over. In addition the use of seed treatment was shown to be beneficial under damp conditions because of the much improved germination.

TITLE: Weed Control in Blueberries

LEADER: M. G. Sampson

OBJECTIVE:

1. To evaluate the sulfonyl urea herbicides including Oust™, Glean™, Ally™, and Harmony™, in both spring and fall applications for control of hexazinone-tolerant weeds, especially bunchberry, which is the most serious weed problem in blueberries.

2. To evaluate various timings of fall applications of 2, 4D-Dicamba to identify the best time to apply these herbicides with the least amount of crop damage and most effective weed control.

3. To evaluate post-emergent applications of several herbicides to which blueberries have shown tolerance inprevious studies.

PROGRESS:

A. Project Description

The herbicide hexazinone (Velpar™) has, in the past, provided excellent weed control in blueberries. However, problems are arising with hexazinone-tolerant weeds. Bunchberry, barrenberry, St. John's Wort and loosestrife are becoming serious problems in many areas. Previous studies (Sampson and McCully 1985, 1986, 1987, 1988) have demonstrated that a group of herbicides known as the sulfonyl ureas hold great promise for control of these weeds. Additional testing is required to provide data in support of registration of these chemicals. In the meantime, it is necessary to find an interim method that growers can apply to prevent the spread of these weeds. Jenzen and North (1986) reported that blueberries may show some tolerance to 2, 4-D/dicamba applied after the blueberry foliage has turned red and abcised. Therefore, early to late fall applications of these herbicides may control these weeds.

Therefore, the objectives of this study are:

1. To evaluate the sulfonyl urea herbicides in both spring and fall applications to provide data in support of registration of these chemicals for bunchberry control in blueberries.

2. To evaluate various timings of fall applications of 2, 4-D/dicamba to identify the best time to apply these herbicides with the least amount of crop damage and most effective control.

3. To evaluate post-emergent applications of several herbicides which do not appear to damage blueberries.

B. Progress in 1988

In 1988, final data recordings were taken on trials established in 1986. These included trials in North River, Londonderry, and Five Islands. In these trials two sulfonyl ureas, chlorsulfuron and sulfometuron methyl continue to give good results. In addition, the herbicide chlorimuron also showed good suppression of bunchberry. The combination of sulfometuron methyl and hexazinone and chlorsulfuron and hexazinone gave excellent control spreading dogbane but were also phytotoxic to the blueberries.

A spring applied trial was established in Earltown to evaluate the sulfonyl ureas for bunchberry control. The chlorsulfuron treatments performed the best. However, rates of other sulfonyl ureas tried may have been too low to have an effect on the bunchberry. High rates will be tried in 1989.

Research Plan for 1989

Pre-emergent trials will be established again in 1989 at various locations looking to the effectiveness of the sulfonyl ureas for control of weeds in this crop. Higher rates as well as larger number of chemicals will be evaluated. These trials will also be expanded to look at the effects of different pruning techniques on control of weeds by various herbicides. Attempts will be made to establish a post-emergent trial to evaluate the effectiveness of several herbicides on bunchberry control in earlay-mid summer. As well, fall applied trials will also be established.

Project 88-96

TITLE: Somatic embryogenesis in red clover

LEADER: Jerzy Nowak

OBJECTIVE: Improvements in red clover by biotechnological means have been essentially non-existent due to difficulties in regenerating whole plants from culture. Ongoing selection at N.S.A.C. for red clover genotypes which will regenerate plantlets from callus culture has yielded 3 selected clones (F49, F329, and F464). Previous work with red clover and other plant species demonstrates that the capacity for regeneration is often highly heritable. Establishment of a regenerative population of red clover would allow selection of superior variants. Upgrading of perenniality by genetic manipulation would also be possible.

Update objectives of the study are as follows:

1) To continue study of cell suspension cultures and to investigate the potential of artificial seed production.

2. To continue evaluations of F329 and F464 petiole calli for regenerative ability.

3. To continue investigations of somaclonal variation.

4. To determine the heritability of the regeneration trait.

5. To evaluate any possible correlation between winter hardiness and the ability of a genotype to regenerate from culture.

PROGRESS:

A significant research effort at the Plant Science Department Tissue Culture Laboratory, N.S.A.C., has centered on developing methods and selecting germplasm which would facilitate genetic improvement of red clover via biotechnology. Past efforts resulted in selection of three genotypes from cv. Florex which were capable of regenerating plantlets from hypocotyl callus. One of the three selected genotypes was also found to be capable of regenerating from petiole section callus and from cell suspension culture. Media protocols were evaluated for efficiency in regenerarating somatic embryos. Several regenerants were acclimated to greenhouse and field condition and somaclonal variation was noted (MacLean and Nowak, 1989).

During the past year further advances were made. Epicotyl-derived plants and hypocotyl callus-derived plants from each of the three selected genotypes were evaluated for regenerative ability from petiole section callus. One genotype

(F49) exhibited a very high frequency of regeneration from petioles of previously regenerated plantlets but exhibited no regeneration from epicotyl-derived plants. The other two selected genotypes (F329 and F464) also showed no regeneration from petioles of epicotyl-derived plantlets. However, one cultured petiole section from and F329 hypocotyl callus-derived plant did undergo regeneration.

Somaclonal variation was observed among pollen viability estimates of F49 regenerants. The average value of pollen viability of F49 regenerants was significantly less than for F49 epicotyl-derived plants (65.1 vs. 91.2%). Hand-crosses between F49 regenerants and F49 epicotyl-derived (mother) plants failed to produce seed, indicating that the S-allele gametophytic imcompatibility system is operating. Observations of field and greenhouse acclimated plants revealed that while the majority of F49 regenerants exhibited some degree of abnormal leaf morphology (at least 2 abnormal leaves per plant) F49 epicotyl-derived plants appeared to be completely "normal". Such evidence further supports the hypothesis that a mutational event affected cells of the F49 hypocotyl callus prior to the onset of regeneration (MacLean and Nowak, 1989).

It is possible to find published reports which state that regeneration capacity in red clover is heritable but we could not find any actual published data to support these claims. Reciprocal progeny of F49 regenerants were therefore produced and evaluated for regeneration from petiole section calli. Of 110 progeny tested to date approximately 35% underwent regeneration. Results of the second and third replications of this experiment are currently winding up. The available data prove that the regeneration trait is controlled by a simply inherited (possibly a single, dominant) nuclear gene. More crossing and progeny evaluations are planned to further characterize the inheritance of this trait.

We were also interested in regenerating from cell suspension cultures of F49 progeny. Suspensions were initiated from petiole section explants. Those progeny which were capable of regenerating from petiole section callus also regenerated from plated suspensions. Such a system will facilitate production of synthetic seeds.

One objective of this study was to evaluate any correlation between winter-hardiness and reneration ability. Forty-nine F49 regenerants and 70 Florex control plants were rated according to vigor after one year in the field. 22.4% of F49's were dead compared to 31.9% mortality of the controls. 40.8% of F49's were classed in the "virgorous" group versus 13.0% of control plants. This data reveals that regenerative ability does not adversely affect vigor and that it may in fact be positively correlated with persistence and yield. A second field planting which included all three selected genotypes along with control plants was carried out in 1988 at the Sutherland site. Vigor at both sites will be evaluated in 1989. <u>In vitro</u> LD-50 calculations are also planned.

TITLE: Selenium content of sheep blood

LEADER: K. S. MacLean
A. R. Robinson

OBJECTIVE:

1. To continue to collect sheep blood samples during the winter and early spring months for selenium analysis during the summer.
2. To complete the evaluation of the selenium status of Nova Scotia sheep.
3. To analyse all the boood samples collected from this project for copper.
4. To examine the relationship between selenium and copper levels.

PROGRESS:

Sheep blood samples, from eight counties and representing eighteen flocks, were collected and analysed for selenium. The average whole blood selenium content was 0.107 ug/ml with an overall range of 0.008 to 0.445 ug/ml.

A total of 255 samples were analysed with 9.4% showing a borderline to deficient selenium content. These deficiencies were limited to the three counties Hants, Yarmouth and Cumberland.

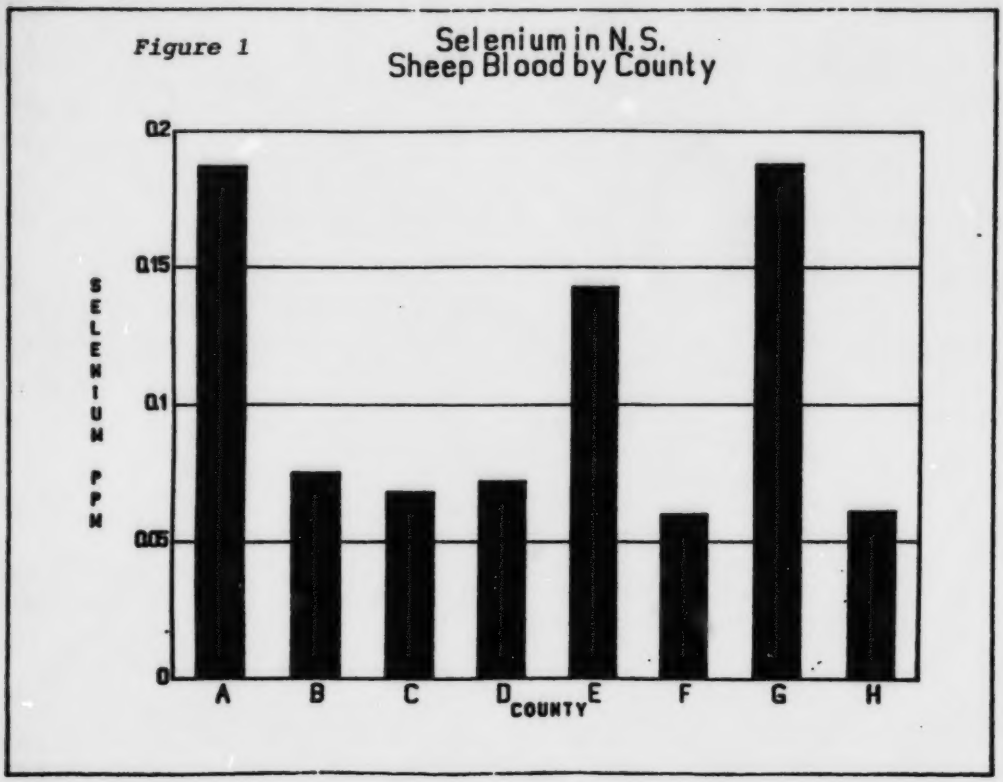
Figure 1 illustrates the distribution of selenium blood levels according to county. Annapolis and Pictou counties have the highest average blood selenium levels and Hants and Yarmouth the lowest.

The copper content was also determined on these whole blood samples. Of the 220 samples analysed, 5% showed a borderline to deficient level. These deficiencies occurred in Yarmouth, Cumberland, Hants, Colchester and Guysborough counties.

The average copper content of all samples was 1.07 ug/ml with values ranging from 0.34 to 2.31 ug/ml. Figure 2 illustrates the blood copper level according to county. The highest average blood copper levels were found in Antigonish County and the lowest in Yarmouth.

It is evident that deficiencies of selenium and copper exist in sheep in Nova Scotia. In the areas where this occurs supplemental selenium and/of copper should be added to the animal diet.

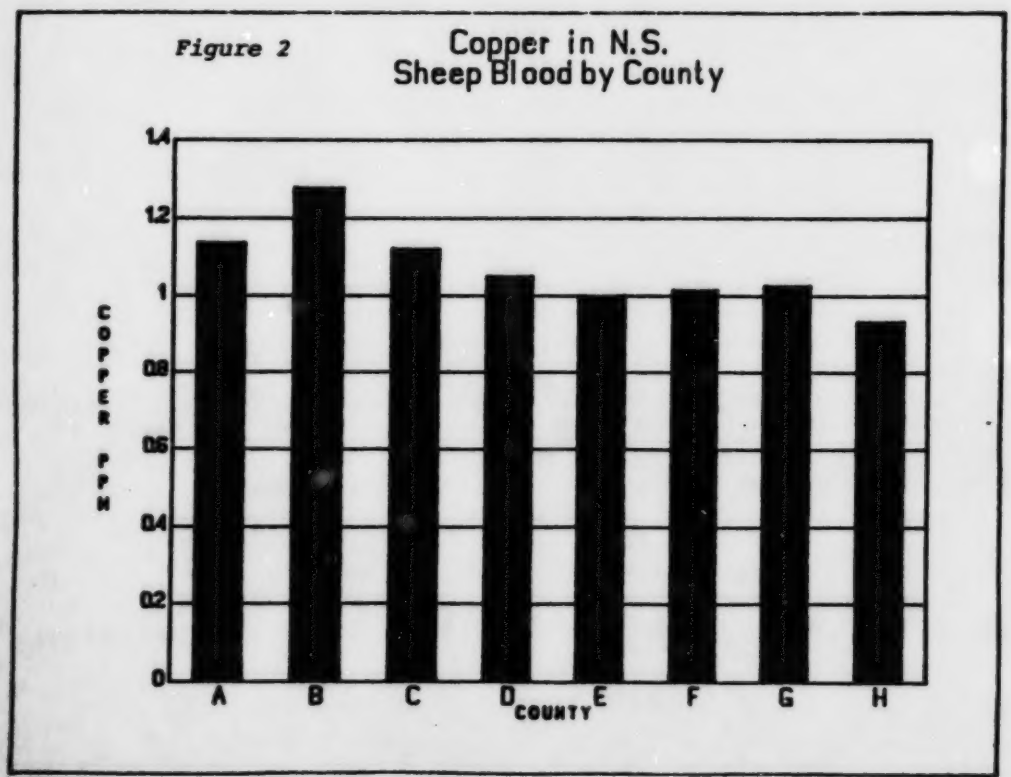
Figure 1



County Legend

A - Annapolis
B - Antigonish
C - Colchester
D - Cumberland
E - Guysborough
F - Hants
G - Pictou
H - Yarmouth

Figure 2



County Legend

A - Annapolis
B - Antigonish
C - Colchester
D - Cumberland
E - Guysborough
F - Hants
G - Pictou
H - Yarmouth

County Legend

TITLE: Propagation and screening of non-traditional sources of stress tolerance in Solanum species

LEADER: D. Midmore

OBJECTIVE:

1. To provide technical assistance to maintain ca. 55 in vitro clones of Solanum tuberosum and wild species as well as true seed propagated wild species.

   These materials are being specially selected from the International Potato Center (CIP) in Lima, Peru. This collection of rare potato germplasm will be unique in Canada.

2. To screen for heat tolerance (high dry matter production, high photosysnthesis and low respiration) and shade tolerance in Solanum tuberosum L. and wild Solanum species.

3. To relate leaf anatomy to rates of photosynthesis in order to devise a short-cut screening technique.

PROGRESS:

Tuber yield is a function of the cumulative radiation interception, the conversion efficiency of intercepted radiation to dry matter (net assimilation on a daily basis), and the partitioning of dry matter to tubers. Under field conditions, high temperature is known to reduce partitioning and conversion efficiency, but has been reported to induce variable effects on radiation interception. Short-term studies on growth rates and carbon assimilation of young plants can provide useful quantitative insights into the response of the potato plants to temperature and irradiance.

Three-week old in vitro-derived potted plants of the clone DTO-33 (heat-tolerant) and cultivar Garhuash Huayro (S. goniocalyx-GH) were placed in Conviron growth chambers set at $33^{o}/25^{o}$C or $20^{o}/10^{o}$C day/night regimes, referred to as hot and cool. An 8-hour photoperiod extension was given in both chambers, following 12 h per day with irradiance at canopy height of 430-450 and 250-280 µmoles $m^{-2}s^{-1}$, in both hot and cool chambers. Thus there were eight treatment combinations including the genotypes. Ten days later plants were harvested from four blocks

for growth analysis. Measures of respiration, photosynthesis (at $\pm$900 µmoles $m^{-2}s^{-1}$), the chlorophyll fluorescence were made at 30°C on one leaf per plant from five blocks. After another 10 days a further harvest and measures of carbon assimilation were made on additional plants from the same blocks. The experiment was run twice.

The main effects of clones, temperature, and light regime were significant for the net assimilation rate (NAR - g $dm^{-2}d^{-1}$). Low irradiance and high temperature reduced NAT by 22% and 43% respectively. Low irradiance and high temperature increased leaf area ratio ($dm^{-2}g^{-1}$) and specific leaf area ($dm^{-2}g^{-1}$) but the greatest values, as for the relative leaf extension rate ($dm^{-2}g^{-1}$) were recorded in the cool, low irradiance combination. Although low irradiance and high temperature resulted in thin leaves, the combination of both did not result in a high relative leaf extension rate (RLER), probably due to the lack of current assimilate for leaf growth.

Dark respiration, following >116 hr in the dark at 30°C, was greater in plants growing under high light (0.802 vs. 0.752 µmoles $m^{-2}s^{-1}$) and low temperature (0.815 vs 0.739), reflecting the greater pool of assimilate under the more favourable growing conditions. When respiration was based on a unit leaf weight basis, only the difference between light regimes remained significant. The net photosynthesis rate per unit leaf area was greater for plants from the hot chamber rate per unit leaf area was greater for plants from the hot chamber (9.189 vs. 7.253 umoles $m^{-2}s^{-1}$), and for leaves produced under hot conditions (i.e., in the comparison between the first and second measures of carbon assimilation, made 10 days apart). This effect is indicative of the photosynthetic adaptation to higher temperature; however, no difference in net photosynthesis was apparent between plants from different light regimes. Photosynthesis was apparent between plants from different light regimes. Photosynthetic rates based upon unit leaf weight were

significantly greater for plants from the hot chamber and from the low light regime.

Chlorophyll fluorescence paramaters (initial, O; peak, P; terminal, T; P-O and P-T) varied significantly between light and temperature regimes, but only variable fluorescence (P-O) differed between clones. In analyses of covariance where carbon assimilation and chlorophyll fluorescence parameters were used as covariates to explain variation between growth attributes and the 8 treatments x clone combinations, photosynthesis markedly reduced the clonal mean squares for total dry weight and most growth attributes, as did the terminal and variable fluorescence parameters. Variation between light regimes in the RLER were not reduced by the covariates of carbon assimilation; however, the temperature effect on RLER and NAR was reduced by T, P-O, and P-T parameters.

The results showed that high temperature and low irradiance interact in the reduction of dry matter accumulation and leaf expansion. These effects were related to measures of carbon assimilation and chlorophyll fluorescence parameters, which may assist, in the future, in screening for genotypic response to heat and shade.

Approximately 54 varieties, breeding lines and species were put into the in vitro conditions prior to running experiments in controlled environment gorwth chambers. Initial experiments were set up, at 30/20^{o} Day/Night temperature with a daylength extension of 6h (to inhibit tuberization) to determine number of replicates for subsequent experiments in which rates of growth photosynthesis, dark respiration were to be measured. In later experiments chlorophyll fluorescence was also measured. Data collection began 10d after exposure to the high temperature conditions (approx. 60d after planting out nodal cuttings) and continued over a 10-14d period, and were later compared with cool grown (20/10^{o}) plants when growth chamber space became available. Significant differences were evident between clones in rates of photosynthesis, respiration and growth, and these, and data on leaf anatomy will be correlated with net productivity under high and low temperatures. Response of leaf photosynthesis to varying levels of irradiance was also measured for a number of clones in the search for indicators of shade tolerance. Adaptation of three clones (including DTO-33 of reputed shade tolerance) to low irradiance was also studied in terms of the above mentioned characters, and the physiological response of clones to Plant Growth Promoting Bacteria (PGPB), and growth retardness in terms of improving heat tolerance, was studied. Leaves produced under high temperatures appeared to utilize high irradiance more efficiently than cool-produced leaves.

Project 88-103

TITLE: N.M.I. In The Study of Forage Structure

LEADER: Andre Lirette, A.B. Gray, D. C. Crober, R. W. Fairfull

OBJECTIVE: To investigate the possibilities to observe with the NMI apparatus:

(a) mineral absorptions and quantatitive content of water in living forages.

(b) mineral absorptions and use of digestive markers such as Cobalt EDTA by animals.

PROGRESS:

Spectroscopy deals with the interaction of electromagnetic radiation and matter. The radiation that is absorbed or emitted by a sample is detected. The output of the detector displayed as a function of the frequency or wavelength of the radiation is termed a spectrum. The spectrum can be interpreted in terms of some aspect of the atomic or molecular structure of the material under investigation.

The various forms of spectroscopy can be classified according to the frequency of the radiation or by the type of transition that is involved. The frequencies characteristic of Nuclear Magnetic Resonance Imaging (M.R.I.) lie in the radio-frequency region of the electromagnetic spectrum. These levels correspond to different magnetic states of atomic nuclei.

Certain atomic nuclei, such as the hydrogen nucleus ^{1}H or the phosphorus nucleus ^{31}P, possess a property known as "spin". This can be visualized as a spinning motion of the nucleus about its own axis. Associated with the spin is a magnetic property, so that the nucleus can be regarded as a tiny bar magnet with its axis along the axis of rotation.

If a magnetic field is applied to a sample containing such nuclei, we might expect the nuclear magnets to align along the field just as a compass needle aligns along a magnetic field. When the scanner excites the protons with a radio pulse timed to the same frequency as their wobbling, it knocks them out of alignment. Within seconds, they spiral back into place, ringing out with a faint radio signal of their own.

Only those nuclei that have magnetic properties or those that possess non-zero spin, give rise to N.M.R. and M.R.I, signals. The abundant isotopes of carbon and oxygen ^{12}C and ^{16}O have zero spin and so do not produce N.M.R. signals.

Some of the pioneering work in magnetic resonance imaging was done at University Hospital in Nottingham, England. Professor Brian S. Worthington described the first images made there in 1974. In 1977 they tried one of the first M.R.I. scans of living human tissue. Two years later a bold scientist volunteer thrust his head into the magnetic field for a brain scan.

Since 1980 the potential of magnetic resonance imaging has become generally recognized, and today some 1000 machines are installed and operating in North America. The explosive growth reflects M.R.I.'s wonderful diagnotic capabilities.

The progress of M.R.I. in agriculture has been very limited and non existent in the fields of plant science and plant pathology. Indeed the cost of the equipment is a major factor in the slow evolution of this technology in agriculture.

In cooperation with the division of Biological Sciences of the N.R.C. in Ottawa, experiments were started during the summer 1987 to evaluate the possibility of using M.R.I. with plant material and with the study of plant pathogenesis. This approach involved the use of magnetic field gradients to provide anatomical images of intact plant systems. During the summer 1988 more experiments were done to compare standard methods used to study plant pathogenesis and this new technique. The possibility to extend N.M.R./M.R.I. techniques to poultry science was also investigated.

Preliminary work has been done to investigate their feasibility. The apparatus used was the Medspec Bruker of the NRC at M40 on Montreal Road in Ottawa. The spectroscopy for eggs was done for hydrogen (^{1}H) and phosphorus (^{31}P). For protons MRS the frequency used was 200.1 MHZ, the recovery time was 0.50 sec and number of averages was 16. It was done in a 4.7T, 33 cm bore superconducting magnet.

For phosphorus spectra, 81 MHZ frequency was used, the recovery time was 5 sec, SW was 50 MHZ. The number of averages was 64 and LB (line broadering) was 20 HZ. The total experiment time was $\pm$ 15 minutes/ sample.

The imaging of the fertilized eggs was done with proton imaging with the sequence - Multi-Echo-Multi- slice method. We used only 1 echo. The frequency was 200.1 MHZ and 4.7T with the Bruker - Medspec.

For the eggs, the field of view (F.O.V.) was 8 cm or 12 cm for transverse sections. The slice thickness was 1.5 - 2.0 mm, slice separation was $\pm$ 2 mm. For coronal scans F.O.V. was 20 cm. The same parameters were used for the rest. T.R. (recovery time) was 0.7 sec. The resolution in plane was $\frac{\text{FOV}}{256\text{- no. of fixels}}$. The average time for one egg was 45 to 60 minutes.

For Plants (sunflower) we did only transverse scans and ^{1}H-proton images. F.O.V. was 5 cm, in plane resolution was approximately 0.2 mm. The slice thickness was 5 mm. The slice separation was 10 mm. To get images we used the sonocoil Bruker ^{1}H coil with large chamber, which is not well adapted to look at plants. Images took about 40min./image. The T.R. was 1.2 sec. Plant imaging time was 1 hr for 2 images.

Preliminary results indicated that relatively good images can be obtained from plants by this approach. Relative quantity of plant water content and inside structures of plant can be seen directly. Evolution of plant pathologies can be followed without destroying the plant. Egg embryos can be visualized and biochemical analysis of the fertilized eggs at different times can be done by this method which is non-invasive and non-destructive. Water and lipid relative concentrations can be evaluated. Different types of lipids can be detected. It might be possible to follow the kinetics of the variations in concentrations of these lipids during the embryonic development of the chick. Different phosphorus compounds can also be detected and they appear to vary with the age of the embryo. Kinetics of these phosphorus variations can possibly be followed. After treatments, the eggs were allowed to hatch. Approximately 96% of the eggs (about 80) hatched with no apparent problem. However, the effect of intense magnetic field during embryo nical growth on post-hatching development is not known. This technique appears to have promise for the fields of Plant Science, Plant Pathology and Animal and Poultry Sciences. Please see figures and spectra in annex.

Project 88-105

TITLE: Effect of Breeding System on Reproductive Performance of Broiler Breeders

LEADER: H. N. Jansen

OBJECTIVE: To compare the relative efficiencies of artificial insemination and natural mating in the production of broiler hatching eggs using the Marshall (European) and Arbor Acres (North American) commercial breeder stocks and breed performance.

PROGRESS:

Egg Production - Hen day egg production for Arbor Acre strain was significantly superior to the Marshall strain fro both floor and caged birds. There was no significant difference in DH egg production for both strains between floor and caged birds.

Mortality - The females of the Marshall strain had higher mortality than the Arbor Acre strain in both floor and caged birds. The Arbor Acre males had higher mortality than the Marshall males in both floor and caged birds.

Fertility - Fertility of the Arbor Acre strain was numerically better than the Marshall strain. Fertility of the artificially inseminated birds (caged) as significantly poorer than for naturally mated birds (floor).

Hatchability of fertile egg - Hatchability of the Arbor Acre strain was numerically better than the Marshall Strain.

HD Feed consumption - Feed allocation for both strains in each housing environment was kept similar. Caged females total feed consumption (22 up to 62 wks) for both strains was 3.5 kg per female lower than for females housed on the floor. Total cage male feed consumption for Arbor Acre strain was 1.6 kg and for the caged Marshall male 2.9 kg lower than for the floor housed males.

Temperature - The daily minimum and maximum ambient temperature was recorded and the weekly average ambient temperature was calculated. Peak feed allocation for caged birds was increased by 6 grams (4°C @ 1.5 gm) due to 4°C lower average temperature than floor birds. Rule of thumb is that caged broiler breeders received 20 grams less feed than floor broiler breeders.

Body weights (laying period) - Female body weights for Arbor Acre and Marshall (Mars except at 56, 62 wks of age) strains were heavier for the floor housed birds as compared to cage housed females. Floor housed male Arbor Acre body weights were heavier during start of the production but lighter during the latter part. The Marshall floor housed males were lighter than the caged housed males during the entire laying period.

Project 88-108

TITLE: Assay For Melatonin

LEADER: M. L. Connor

OBJECTIVE: To establish a valid radioimmunoassay for blood melatonin. To quantitate blood melatonin levels in fox during furring and reproduction (completion of 410-061).

PROGRESS: Initially, an assay used for human plasma was tested. While showing promise it required considerable refinement and some modification before validation. As well, the requirement for an extraction step was time consuming, had more potential health hazard and was a ready source of error.

However, development of a direct radioimmunoassay has helped to eliminate or minimize these problems. It appears satisfactory for measuring serum melatonin in fox blood.

Project 88-110

TITLE: Water Quality For Pigs

LEADER: D. M. Anderson

OBJECTIVE: To investigate the effects of water high in total dissolved solids (tds) or with modified Ph on the utilization of nutrients by the pigs.

To establish effects on the metabolism of pigs when water high in individual salts (sulfates, chlorides) are provided.

PROGRESS:

Analysis is currently underway on the experiment involving high chloride water treatments. Digestibility values are currently being determined and are within 3 weeks of completion (Dry matter (DM) crude protein (CP) and energy). Urine analysis for energy, CP and DM are partially completed. Mineral analysis of the feeds has been delayed pending the task to make the atomic absorption instrument in Animal Science functional. Initially it was thought the ICP (Feed's Lab) could be used but the high salt content of the waters and high chromic oxide content of the feed render this metholology inappropriate. The calcium, phosphorus, sodium, and potassium will be analysed within 2 months. Preliminary results indicate elevated water consumption and urinary volumes with higher total dissolved solids in the water. These values will be made much more informative with the addition of data on the minerals. The data will be examined to indicate routes of excretion of the salts .

		Barn	High Salt Waters			
	Distilled water	water supply	900+ppm	4000+ppm	7000+ppm	10,000+ppm
Water consumption (L/day)	20.14	17.34	20.35	17.71	20.94	27.09
Urine excreted (L/day)	12.44	10.73	13.04	10.97	14.08	20.79

TITLE: The Biology and Control of Coltsfoot (Tussilago farfara L.)

LEADER: Douglas J. Doohan and Lise A. LeBlanc

OBJECTIVE:

1. To develop control practises for Coltsfoot in pre-plant situations, cropping systems and non-agriculture situations.

2. To study the reproductive strategy of Coltsfoot.

PROGRESS: One biology and three weed control studies were established in 1987. Coltsfoot control studies established at Great Village, Colchester County were: Control of Coltsfoot in Barley, Pre-plant Control of Coltsfoot and Pre-emergence Control of Coltsfoot.

Control of Coltsfoot Sprayed at Bloom was put out in the spring of 1988. All the trials were re-evalauted in 1988 for long term control. The biology study was the determination of longevity of coltsfoot seed viability.

Coltsfoot Control in Barley

Nine herbicides were tested for selective control of emerging Coltsfoot ramets in emerged spring barley. None of these materials provided satisfactory control of Coltsfoot. There was no residual control in 1988.

Pre-Plant Control of Coltsfoot

Thirteen treatments of seven herbicides were evaluated for pre-plant control of Coltsfoot. Each treatment was applied at three different timing windows during 1987 (early July, mid-August and late September). Glyphosate was not effective when applied in early July, however, mid-August treatments provided excellent control. Rates of 1.0, 2.0 and 4.0 kg a.i./ha provided identical control. It continued to give some residual control in 1988.

Clopyralid at 0.30, 0.60 and 1.20 kg a.i./ha provided effect of rates. It continued to give excellent control in 1988 (90-95% control). A tank mixture of 2.0 kg a.i./ha 2,4-D amine plus 1.0 kg a.i./ha dicamba was ineffective when applied in early July but provided 75% control when applied in mid-August.

The plots were rated again in 1988. It can be concluded that application of growth regulating herbicides in the spring, after crop and broadleaf weed emergence, have not provided adequate control of Coltsfoot. This may have been due to a lesser weed coverage than later in summer. Additionally, translocation patterns in the plant may have prevented movement of herbicides to the root system. Fall application of glyphosate, clopyralid and amitrol-t gave the best long term control of Coltsfoot.

Pre-emergence Control of Coltsfoot

Eleven treatments were evaluated for pre-emergence control of Coltsfoot. Herbicides were applied on July 21, 1987 to a recently prepared seedbed. Coltsfoot regeneration appeared to be primarily from regenerating rhizomes. Chlorsulfuron was the only herbicide that provided consistant control.

The plots were rated again in 1988. Atrazine, hexazinone and chlorsulfuron gave the best control by late summer and fall. Chlorsulfuron still provided continuing control by fall. of 1988.

Control of Coltsfoot Sprayed at Bloom

Nine treatments were evaluated for control of Coltsfoot at bloom. Herbicides were applied on May 2, 1988. Chlorsulfuron appears to be an acceptable control of 0.10 kg a.i./ha. Two applications of chlorsulfuron should be evaluated in successive springs to see if eradication is possible. Dicamba and atrazine were not effective at agricultural rates.

Biology Study

Studies on the viability of Coltsfoot seed confirmed reports of high viability in freshly harvested seed followed by a rapid decline to zero viability with two months of seed collection.

Summary

Progress to date shows several chemicals that have good possibilities for long term control or complete eradication of Coltsfoot. These chemicals include clopyralid, amitrol-t, glyphosate, chlorsulfuron and hexazinones.

It can be difficult to draw conclusions about long term control in small plot trials. Coltsfoot rhizomes can grow three meters in one season. It is impossible to draw accurate conclusion because the rhizomes from an adjoining plot may cross over to the controlled plot leading one to conclude that it was not controlled 100%. We will assess long term Coltsfoot control on large field scale demonstration sites using the chemicals showing the best control.

Project 88-113

Title: Artificial dwarfing of 'Trillium' triticale

Leader: C.D. Caldwell

Objective: To evaluate plant growth regulators for artificial dwarfing of 'Trillim' triticale

Progress: In 1988 at the CDA Experimental Farm at Nappan, N.S., small plot replicated field trials evaluated the effects of Cycocel (CCC, chlormequat chloride), Cerone (ethephon) and Terpal C (CCC + ethephon) on 'Trillium' winter triticale. The PGR's (plant growth regulators) were tested at 3 different combinations of timings: 1) Zadoks Growth Stage (ZGS) 30 and 32; 2) ZGS 30 and 37; and 3) ZGS 32 and 37, in order to determine the best timing for application. All sequential combinations of the three PGR's were tested at the following rates: CCC @ 1·38 Kg ai/ha; Cerone @ 0·92 Kg ai/ha; Terpal C @ 1·38 Kg ai/ha. Plant heights, lodging, delay of heading and maturity and eventual grain yield were all evaluated.

Plant height was reduced by all PGR's to varying amounts dependent on type of PGR and timing of application. The greatest amount of shortening by a single application resulted from Cycocel @ ZGS 30 or 32. The most effective dwarfing combination was CCC @ ZGS 30 or 32 followed by Terpal C @ ZGS 37.

Unfortunately, for the first time in several years, lodging was not a problem in winter triticale at Nappan; there was no lodging under any treatment in these experiments.

The same PGR's which caused maximum straw shortening also caused depression of yield due, at least partially, to a depression of hectolitre weight. Cerone did not tend to cause test weight decreases but it also produced the least shortening effect. CCC produced the greatest dwarfing effects but depressed test weight and yield. Terpal C was intermediate in its effects.

This work is continuing under funding from the NS/Canada ALFI Technology Development Program.

TITLE: Mineral Metabolism in Ruminants

LEADER: A. H. Fredeen

OBJECTIVES:

1. To examine whether high dietary potassium or high dietary calcium in pre-partum dairy diets is responsible for parturient hypocalcemia (milk fever) in ruminants consuming alfalfa diets.

2. To examine magnesium metabolism in ruminants fed high potassium diets, with or without high ruminal ammonia.

3. To compare apparent calcium and magnesium availabilities to true availability determined using radioisotope dilution techniques.

PROGRESS:

A. SUDDEN LOSS OF CALCIUM FROM THE EXCHANGEABLE CALCIUM POOL STIMULATES BONE CALCIUM RESORPTION IN MATURE SHEEP

Two groups of three mature, non-lactating, non-pregnant ewes (averaging 60 kg body weight) were used to assess the capabilities of sheep to meet their metabolic calcium (Ca) requirements when fed recommended levels of Ca (4.06 g d^{-1}) and confronted with a simulated lactational Ca loss. Irreversible Ca loss was established at 1 g Ca d^{-1} in three ewes via continuous infusion of an isotonic solution of ethylene glycol-bis (β-amino ethyl ether) N, N, N^1, N^1 - tetra acetic acid (EGTA). Control ewes were not infused. Calcium absorption and metabolism were monitored using a radiodilution technique. Serial blood, fecal and urinary samples were collected over 7d after a single iv injection of $^{45}CaCl_2$ (216.9 μ Ci ^{45}Ca). A four-compartment model of Ca metabolism was fit to plasma radiocalcium decay and urinary and fecal radiocalcium excretion data. All ewes exhibited positive Ca balance (control: 1.78 g d^{-1}; infused: 0.90 g d^{-1}). Size of exchangeable Ca pool dropped from 72.05 to 14.63 g d^{-1} in infused ewes. Concurrently, Ca resorption from bone increased significantly ($P<0.05$) (control: -1.38 g d^{-1}; infused: 1.82 g d^{-1}) while rate of Ca absorption showed a nonsignificant change (control: 1.80 g d^{-1}; infused: 1.94 g d^{-1}). Efficiency of dietary Ca absorption (control: 44.3%; infused: 47.8%) approached maximum based on previous investigations, indicating that level of dietary Ca used in this trial was near requirement for mature lactating ewes depositing 0.9-1.8 g Ca d^{-1}.

B. EFFECTS OF DIETARY MAGNESIUM AND POTASSIUM ON CALCIUM METABOLISM IN EWES DURING SIMULATED LACTIONAL CALCIUM LOSS

Effects of dietary levels of magnesium (Mg) and potassium (K) on sudden calcium (Ca) loss Ca absorption and metabolism in ewes were studied to determine how Ca status is affected in situations that predispose ruminants to grass tetany. Six mature, non-lactating, non-pregnant ewes were randomly assigned to 3 dietary treatment groups in a latin square design. Group 1 (RR) received recommended levels of dietary K (12.32 g d^{-1}) and Mg (3.36 g d^{-1}); group 2 (LL) received low levels of dietary K (8.40 g d^{-1}) and Mg (2.31 g d^{-1}); group 3 (HL) received high levels of dietary K (30.59 g d^{-1}) and low levels of Mg(2.10 g d^{-1}). Lactational Ca loss was simulated in 1 ewe (infused) from each of the three dietary treatments via continuous iv infusion of ethylene glycol-bis (β - amino ethyl ether) N,N,N'N' - tetraacetic acid (EGTA); 1 ewe (control) of each dietary treatment was not infused. Calcium balance data and serial blood, fecal and urinary samples were collected over 7 d after an initial iv injection of $^{45}CaCl_2$ (216.9 μ C; ^{45}Ca). A 4 compartment model of Ca metabolism was fit to the data. All ewes with the exception of one exhibited a positive Ca balance (control: 1.62 g d^{-1}; infused: 1.09 g d^{-1}); there were no significant ($P<0.05$) treatment differences. Across all diets, infused ewes had significantly higher ($P<0.05$) bone Ca resorption rates than control ewes (RR-control: -1.38 g d^{-1}; RR-infused: 1.82 g d^{-1}; LL-control: 0.24 g d^{-1}; LL-infused: 2.51 g d^{-1}; HL-control: -1.60 g d^{-1}; HL-infused: -0.97 g d^{-1}. Absorption was not significantly increased ($P>0.05$), though both efficiency and rates of Ca absorption were higher (RR-control: 1.80 g d^{-1}; RR-infused: 1.94 g d^{-1}; LL-control: 1.07 g d^{-1}; LL-infused: 1.29 g d^{-1}; HL-control: 1.99 g d^{-1}, HL-infused: 3.23 g d^{-1}). Overall, size of exchangeable Ca pool was diminished by the sudden Ca loss (RR-infused:14.63 g d^{-1}; RR-control: 72.05 g d^{-1}). Differences were significant ($P<0.05$) only in the RR group. Diets containing high or low K levels combined with low Mg level do not appear to adversely affect Ca absorption and metabolism in mature ewes relative to diets containing recommended levels of K and Mg.

Title: Nutritional evaluation of Nova Scotia grown triticale

Leaders: D.M. Anderson and C.D. Caldwell

Objective:

1) To determine the coefficients of digestion of triticale cultivars grown in Nova Scotia

2) To estimate the protein quality in triticale cultivars using rat growth trials

Progress: An evaluation of the nutritional value of fourteen varieties of triticale, 'Max' wheat and 'SM27R' rye was conducted using three-week-old male Sprague Dawley rats. Each of the seventeen diets (including the casein control) was randomly assigned to seven individually housed rats. Diets were provided ad libitum and water was available at all times. The rats were weighed and feed consumption was recorded weekly for a period of three weeks. Weight gain, feed to gain and protein efficiency ratio (PER) were calculated on a weekly basis as well as for the entire experimental period.

The SM27R rye and Beaguelita triticale had a significantly higher weight gain than the other grains tested. Wheat had the lowest weight gain but was not significantly lower than QTS.52 and 82ITSN142 triticales. The other cultivars and experimental lines of triticale varied between these.

Rye and Beaguelita also had the lowest feed to gain ratio and wheat and QTS.52 were significantly poorer than the others.

The protein efficiency ratio (PER) of rye was significantly higher than that of triticale or wheat. 82ITSN142 and QTS.52 triticales were similar to each other and significantly lower than the other triticales. The various other varieties of triticale fell significantly below rye with Beaguelita, Triwell, QTS.20, 82ITSN145, QTS.15, 82ITSN169, QTS.30 and 82ITSN153 being significantly higher than the rest but not differing significantly among themselves.

From this study it can be concluded that differences exist among cultivars of triticale but that in general Beaguelita, QTS.30 and Triwell seem to show the best results, with Beaguelita equal to rye in most cases and these cultivars being significantly better than 'Max' wheat. Palatability did not seem to be a problem with the triticale cultivars used in this study.

In rats the nutritional value of triticale depends on the cultivar involved but even the poorest cultivar in this study were at least equal to wheat in protein quality. Rye appeared to produce the greatest gains and the best protein quality. It appears that the protein quality of triticale cultivars are variable but some are comparable to that of rye.

Project 88-116

TITLE: The Use of Immobilized Enzymes in Soil Organic Matter Research

LEADER: P. R. Warman

OBJECTIVES:

(a) To fractionate soil organic matter on the basis of molecular weight.

(b) To separate and identify the presence of peptides.

(c) To determine the constituent amino acids using immobilized proteases and RP-HPLC.

PROGRESS:

Organic matter was removed from three Canadian soils using a relatively mild extraction procedure. Gel-permeation chromatography was used to fractionate soil organic components on the basis of molecular weight. Peptide material was recovered from low-molecular weight (LMW < 5000 daltons) organic matter extracts using reversed-phase high performance liquid chromatography (RP-HPLC), absorbance detection (at 214 nm), and integrated peak collection. Immobilized proteases attached to different inert supports were used in column and batch systems to hydrolyze the collected soil peptide material into their constituent amino acids. The enzyme support matrix and the system of enzyme hydrolysis appear to influence the release of amino acids from LMW peptide fractions. Greater quantities of amino acids were released from LMW peptide hydrolysates of cultivated soils than from an uncultivated soil.

Publications forthcoming:

Warman, P.R. and Isnor, R.A. 1989. Evidence of peptides in low molecular weight fractions of soil organic matter. Biology and Fertility of Soils; in press.

Warman, P. R. and Isnor, R.A. The amino acid composition of soil peptides hydrolysed by different immobilized proteases attached to different supports. In preparation, Biology and Fertility of Soils.

Project 88-117

TITLE: Boundary Layer Microclimate as Affected by Plastic Tunnels

LEADER: R. Gordon

OBJECTIVE: To examine short term (1 minute) changes in the microclimate above and below the soil surface as affected by row tunnels. As a result we hope to obtain a better understanding of the abrupt temperature fluctuations and energy patterns that occur inside the closed environment of various tunnels especially during extreme heat risk periods.

PROGRESS:

Plastic row tunnels have been used successfully for a number of years throughout North America. By moldifying the plant microclimate these tunnels in fact magnify the intensity of the growing season. In doing so other favorable conditions are encountered. Namely suppression of some weeds, reduction of water loss from the soil, a prolonged growing season and improved success of germination for some crops.

In Nova Scotia the major limiting factor for agriculture is the relatively short, cool growing season. Microclimate modification with row tunnels or mulches for Nova Scotia vegetable and berry crops is of increasing interest for obtaining a strong supply of produce early in the season. However, their adoption has been rather slow as compared to other areas of Canada.

The capacity of the tunnels to increase their heat accumulation as compared to that of the natural environment is quite apparent. Average temperatures can be expected to be usually 5 to 6^{o}C warmer under plastic tunnels on clear sunny days that with open conditions. However, the use of the plastics is often accompanied by frequent large fluctuations of the temperature inside the tunnel as compared to the outside air temperature or the temperature inside another type of tunnel (i.e. fabric). The main problem with using plastic tunnels results from the excessively high temperatures that are often encountered and the risk that they may disrupt growth or be lethal to some heat sensitive crops. Their are probably no crops presently grown in Nova Scotia that can withstand the high temperatures that occur inside the tunnels under clear warm conditions for a significant length of time.

With respect to the ventilation properties of the tunnel, if manual lifting is expected to take place it may be more efficient if possible to orient the tunnel perpendicular to the direction of the prevailing wind. Also a plastic with more perforations per unit area may facilitate in sufficiently lowering the

temperature of the tunnel as compared to a tunnel with less performations.

The use of the fabric as a tunnel cover showed favourable response but in some situations (i.e. low net radiation) the temperature inside was less than the air temperature outside the tunnel.

Project 88-118

TITLE: Sediment Clogging in Nova Scotia Drainage Tiles.

LEADER: Gordon R. Brewster

OBJECTIVE:

The proposed research will attempt to characterize the organic, inorganic and fluid nature of the clogging sediments found in Antigonish County, Nova Scotia and compare it to other known clogging sediments found in selected Nova Scotia drainage tiles. Research will center on the following:

1. Isolation and identification of the contained fungi and bacteria in order to characterize the microbial component.

2. Analysis for total organic carbon, humic acid carbon, and fulvic acid carbon in order to characterize the organic component.

3. Particle size and mineralogical examination (clay- and silt-sized), along with detailed iron and aluminum oxide determinations in order to chacterize the inorganic components of the clogging sediments.

4. Characterization of the drainage waters and soils surrounding the time drain network for determination of iron, aluminum and manganese concentrations and iron speciation.

5. Spatial determination of extractable Fe in order to determine correlations between regional/spatial distributions and problem areas. This may help to determine "trouble spots" prior to drain installation.

PROGRESS:

Phase I of this application involves the completion of work initiated in the 1988 grant year. During the summer of 1988, soil sediment, and fluid samples were collected from farm fields where iron ochre clogging of drainage systems had been identified by Mr. L. Cochrane, Nova Scotia Drainage Supervisor. Farms were sampled in a range of geographic locations, geologic materials and site-specific situations. At each of the detailed examination sites, bulk samples of soil horizons and layers were obtained for chemical and physical analysis and undisturbed/oriented samples were obtained for micromorphological analysis. In addition, fluid and iron ochre samples were obtained from tile outlets and drainage ditches within or adjacent to the field. The sampling/field work phase of the research is complete.

Laboratory analysis of the collected samples is only partially complete. Samples were analysed for organic carbon, total

extractable carbon, humic acid carbon, and fulvic acid carbon. The analysis of the organic components of the collected samples is complete. Collected samples were analyzed for sodium-citrate-bicarbonate-dithionite (SCBD) extractable, sodium oxalate extractable, and sodium pyrophosphate extractable Fe, Al and Mn. These extractions are used to isolate both the stable crystalline and mobile amorphorous and organically-complexed fractions of these elements. This work is complete. The undisturbed and oriented samples have been freeze-dried, a step necessary prior to impregnation with resins for micromorphological analysis. Trial impregnations yilelded a 60% success rate, a rate which later improved to 80% with resin/acetone/hardener ratio changes. Work on sample impregnation is progressing and creation of thin-section slides is being initiated. Particle-size, mineralogical and fluid analyses has yet to be initiated.

Phase II - Some drainage schemes in Nova Scotia have severely reduced effectiveness due to the obstruction and sealing of internal volumes and external porosities by "ochreous deposits". Ochre is a red to yellowish or tan genatinous clogging deposit containing extensive amounts of iron in association with bacterial slimes (Ford, 1982a). Subsurface tiling of imperfectly and porly drained soils is a common practice in Nova Scotia, and in many cases these drainage systems are either slowed down or rendered inoperative by iron oxide deposits. Because iron ochre has the ability to cause failure by clogging of gravel envelopes, water inlet openings, and the internal volume of drains, determination of iron ochre hazard prior tile installation becomes paramount.

A field-testing procedure has been developed which estimates the iron ochre potential in agricultural drains (Ford, 1982b). The procedure estimates Fe^{2+} levels that occur in the soil solution (groundwater), either with soil samples incubated in the laboratory or from groundwater tested directly in the field. The field-testing kit developed by Ford (1982b) has been adapted for use in Quebec (L. Cochrane, personal communication). Using the kit, one may:

1. Indicate whether a soil zone may be deficient or high in soluble Fe^{2+} under flooded conditions.

2. Indicate whether the soil is deficient in suitable energy for reducing bacteria.

3. Indicate whether iron on the soil particles is readily reducible.

4. Indicate whether the Fe^{2+} may be flowing in from surrounding areas or escarpments.

This phase of the grant application will involve the manufacture

and refinement of the field-testing kit as it is applied to Nova Scotia soil conditions. The field-testing kit will allow drainage engineers to test localized (on-farm) conditions prior to tile installation, and it will also allow for the determination of the spatial extent (regional) and environmental determinants of problem areas. Knowledge pertaining to any or all of these areas will aid in the more effective allocation of drainage program resources and assist in the evaluation of drain efficiency of established schemes.

Title: Mycotoxins in Silage

Project 88-119

Leader: A. Bruce Gray

Objective: To evaluate moldy silage samples for the presence of mycotoxigenic molds and mycotoxins.

Progress:

One gram samples of moldy and unmoldy silage were collected from eight sources in the province, chopped up, suspended in sterile distilled water, diluted up to five-fold and pipetted onto a solid nutrient medium containing salts, glucose, 2,4-dichlorophenoxyacetic acid and the antibiotics tetracycline HCl and streptomycin sulfate. The fungi growing from the plated samples were isolated onto potato dextrose agar and identified. Mycotoxigenic genera, which were present in both moldy and unmoldy silage, included Fusarium, Aspergillus, and Penicillium. Highest concentrations of fungal propagules were found in the moldy silage.

Mycotoxins were extracted from samples for analysis by thin layer chromatography. Five grams of sample was extracted with 20 mL absolute ethanol. The ethanol was filtered through filter paper and passed through a clean-up column containing cotton wool saturated with 84% acetonitrile, diatomacious earth, and a charcoal-alumina mixture. The ethanol was evaporated off the samples, and the samples were redissolved in 5 mL acetone.

Alternatively, 5 g samples were extracted with acetonitrile and potassium chloride, filtered, the lipids removed with hexane and the acetonitrile fraction passed through a column of cotton wool saturated with sodium sulfate. The solvent was evaporated off and the residue dissolved in a 1:2 mixture of methanol and chloroform.

TLC plates coated with silica gel G were sprayed with a solution of aluminum chloride - water - ethanol (10: 15: 85, w/v/v/) and air dried for 24 hours. The plates were cleaned with chloroform - acetone - 2-propanol (14: 3: 3), and air dried for 24 hours again before spotting with 15 ul of the samples. Controls included seven mycotoxin standards and a sample extracted from grain known to contain 11 ppm deoxynivalenol. The standards included deoxynivalenol, T-2 toxin, zearalenone, Aflatoxin B_1, Aflatoxin B_2, Aflatoxin G_1, and Aflatoxin G_2, some of the mycotoxins commonly associated with the fungi isolated from the silage samples.

The plates were developed in chloroform - acetone - 2-propanol (8: 1: 1), air dried, heated at 120°C for 8 minutes, and cooled. The toxins were observed as blue fluorescent spots under long wave UV light.

Although most of the extracts produced fluorescent spots, none of the silage extracts produced spots with Rf values similar to any of the standards. Spots were observed in extracts from both moldy and unmoldy silage. The grain extract produced a spot at Rf 0.75, which was also the Rf value for deoxynivalenol. The results suggest that the silage samples did not contain the toxins used as standards, but did contain unknown substances with some properties similar to mycotoxins.

Project 88-120

TITLE: Greenhouse Crops - New Crops, New Cultivars, and New Practices

LEADER: L. Mapplebeck

OBJECTIVE: To evaluate new greenhouse crops (e.g. potted carnations, greenhouse peppers), new cultivars of greenhouse crops presently grown (e.g. miniature roses) and to examine cultural practices (use of plant growth retardants, propagation methods, etc.) of crop of importance or potential importance to the Nova Scotia greenhouse industry.

PROGRESS:

Miniature Roses - Fifty-three cultivars of miniature roses were obtained and evaluated for yield of softwood cuttings per stock plant and ease of rooting of the cuttings. Cultivars varied threefold in yield of cuttings per stock plant and rooting success varied from very easy (for example Cri Cri, Bo Peep, and Sunny Day) to fairly difficult (for example, Littlest Angel, Cornsilk, and Pinstripe). Much of the work on this crop during 1988 was devoted to propagation of plants for research trials in 1989. More than one thousand plants were propagated and grown for this purpose (i.e. for forcing in late winter/spring of 1989). One experiment using a "fast track" production system was undertaken during 1988. The fifty three cultivars were propagated with four cuttings per rooting cube and 4 replications. Plants were grown and evaluated during the fall and winter period. Most cultivars did not flower due to low light conditions. Those that did flower were Bo Peep, Cinderella, Gold Mine, Happy Hour, Julie Ann, Chatham Centennial, Littlest Angel, Pink Hit, Pinstripe, Potluck White, Potluck Yellow, Spice Drop, Cri Cri, and Lynn Gold. These results are preliminary and more indepth studies are continuing.

Greenhouse Peppers - Three cultivars of indeterminate hybrid greenhouse pepper cultivars were evaluated in a hydroponic (N.F.T.) system during the summer of 1988. The cultivars were Doria (yellow fruit), Latino (red fruit) and Novi (red fruit). Yield data was collected. Pruning and training systems were also examined. Doria produced the smallest fruit of the three cultivars. Novi produced the largest fruit. Doria and Novi produced fruit earlier than Latino. Novi produced the highest yield of marketable fruit. Work presently continues following this preliminary study on this new crop.

Pot Carnations - Ten cultivars of a new crop, pot (dwarf) carnations were evaluated as 10 cm and 15 cm pot crops. This crop turned out to be difficult to grow with many production problems. Many commercial growers throughout North America reported similar problems, thus reinforcing the need for further research on this crop. After identifying these problems a second crop in the winter and this year's (1989) research is meeting with success.

Propagation of Woody Plants - A wide range of deciduous shrubs were propagated to determine ease of propagation in various propagation media. Some species (for example, Potentella fruticosa and Spirea x bumalda) were successfully rooted (> 95%) in Oasis rootcubes in as little as 13 days. These preliminary studies provided valuable data and information for more indepth studies which are now underway.

Project 88-121

TITLE: Analysis of Meat and Meat Products by HPLC

LEADER: A. R. Robinson

OBJECTIVE:

1. To validate an analytical High Pressure Liquid Chromatography (HPLC) procedure for determining protein profiles of meats.

2. To show that HPLC can be used to identify different meat proteins from various species (eg., beef, pork, poultry, etc.).

3. To show that the HPLC procedure could be used to determine if a meat product has been adulterated with other meats or with a vegetable protein.

PROGRESS:

Samples of lean ground beef, pork and chicken were prepared for analysis by adding water and blending for 5 min. in a Waring Blender. The homogenate was filtered through Whatman No. 4 filter paper and sodium azide was added (final concentration of 0.01% w/v) as a preservative. An aliquot of the filtrate was then filtered through a 0.45 um membrane nylon filter prior to injection into the high pressure liquid chromatograph (HPLC).

The chromatography parameters were as follows: HPLC-Beckman, column - large pore reverse phase supelcosil LC-318, mobile phase - gradient program of 37-60%, Solvent B (950:50:1) - acetonitrile:water:trifluroroacetic acid) in 55 min., Solvent A - 0.1% trifluoroacetic acid. Detection was done using a UV detector set at 280 nm.

Results showed that each meat sample did yield a characteristic chromatographic profile; however, the profiles were not reproducible from run to run. The separations under these conditions failed to yield any reproducible characteristic peaks which could be used to identify the meat samples.

Accordingly, the technique known as electrophoresis was applied to the identification of the various proteins. In its many forms, electrophoretic techniques can serve to characterize molecular arhitecture, determine homogeneity, and quantitative proteins. Under appropriate conditions, subtle differences in molecular properties such as those due to posttranslational modifications or genetic variation within protein classes can be determined.

Samples of meat proteins from various species were run on polyacrylamide gel electrophores (PAGE) as well as solium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). The

results were very encouraging and definite differences were observed in the protein patterns. However the separations were not sufficient to positively identify the various proteins.

Accordingly, the technique known as iso-electric focusing was employed and preliminary results indicate success. Using this technique we are able to positively identify proteins from various species such as beef, poultry, pork, venison and moose. The object of the project will be to expand this technique so that we can identify meat samples that have been adulterated with other proteins. Once a reliable procedure has been developed it could be used to identify genetic variations within species of plants and animals.

Project 88-122

TITLE: Space Use By Stall Housed Calves

LEADER: T. Tennessen

OBJECTIVE: To measure the amount of space calves require to rest comfortably, and to determine its relationship to weight, height, stance length and ambient and floor temperature.

PROGRESS:

At the final 1987 meeting of the committee convened to draw up a Recommended Code of Practice for the Care and Handling of Veal Calves, the issue of space requirements of calves was a contentious issue. It was concluded that more information is needed.

The May 1988 report of the Canada Committee on Animal Production Services lists "penning of special-fed Veal Calves" as a High Priority research topic.

In 1988, preliminary work was done to assess the feasibility of using computer image analysis along with time-lapse video recording to quantify the geometric space needed by calves while standing, getting up, lying down, lying in sternal or lateral recumbancy, or while grooming.

Findings show that our equipment can handle this kind of information and provide objective data on actual space "needs".

Project 88-123

TITLE: Hydroxyproline resistance, a selection method for developing winter hardy alfalfa

LEADER: Jerzy Nowak

OBJECTIVE:

Breeding crop varieties for stress environments became the major objective of developmental programmes in agriculture (Blum, 1985; Li, 1984). In the Atlantic Provinces of Canada, freezing injury is considered to be a prime factor limiting the yield of forage crops (Suzuki, 1984). A cold, wet winter climate with frequent freezing and thawing leads to the loss of plant hardiness and by the end of the season, severe injuries occur. There are numerous reports indicating that accumulation of proline protects higher plants against frost injury (reviews: Stewart & Lahrer, 1980; Aspinall & Paleg, 1981). Recently VanSwaaij *et al*. (1987) and Kueh and Bright (1981) obtained, respectively, cold stress tolerant potato and barley as a result of screening for hydroxyproline resistant variants using *in vitro* techniques. Hydroxyproline, an analog of proline, causes death of cells or plants with low proline content. Only overproducers of proline can survive when an excessive amount of hydroxyproline is used as a selection pressure. Cell suspension culture, using highly regenerative genotypes of cultivated crops, became a major tool in screening for stress tolerant variants using this techniques. Proline accumulation reflects tolerance to other environmental stresses as well.

In our laboratory, highly regenerative genotypes of alfalfa (Matheson *et al*., in preparation) and red clover (MacLean & Nowak, submitted) have been selected from cultivars adapted to Maritime conditions (Algonquin and Apica alfalfa and Florex red clover). All of these genotypes generate suspension cultures to which selection pressure can be applied, and plants can be regenerated from the survived material. In preliminary studies we have also found that *in vitro* grown plantlets respond similarly to the hardening conditions as do field grown plants.

The objectives of the research are as follows:

1. To produce hydroxyproline resistant cell lines of alfalfa and red clover.

2. To regenerate plants from the selected variants and compare their LI_{50} values to the mother plants.

PROGRESS:

Cell suspension cultures of red clover were initiated from petiole sections of plants which had proven to be highly regenerative from petiole section calli (MacLean and Nowak,

1989). Eighteen suspension cultures were established. After 56 days in culture, 10 ml of suspended cells were subcultured from each flask to 40 ml fresh culture medium. At the same time, 1 ml of suspension was plated onto 8 ml agar-solidified media containing 0, 2.5 and 5.0 mM hydroxyproline in 60 x 20 mm Petri dishes. Two replicates of each concentration were employed for a total of 6 plates from each flask (108 plates in total). This procedure was repeated after 51 days with the 18 suspensions.

The first group of plates was evaluated for growth 75 days after plating. Proliferative, regenerating cultures grew on 6 plates containing 0 mM Hyp and on 1 plate containing 2.5 mM Hyp. The tissue on each of these 7 plates was divided so that one third was plated on 0, 2.5 and 5.0 mM Hyp medium (21 plates in total). From the second group of plated suspensions, proliferative cultures are growing only on plates with 0 mM Hyp. These cultures will also be divided and plated on 0, 2.5 and 5.0 mM Hyp medium.

There are several reports in the literature that cell culture in the presence of 2, 4-D increases the frequency of genetic variation. Plans are underway to initiate red clover suspensions in the presence and absence of 2, 4-D; to continue screening for hydroxyproline resistance in suspension as well as in plated cultures; and to evaluate plants which have regenerated from hydroxyproline resistant cultures.

Techniques have been evaluated for initiation, maintenance and regeneration of alfalfa cell suspension cultures. Selection for resistance to hydroxyproline is planned in the immediate future following procedures similar to those employed for red clover. Regenerative genotypes selected from the locally adapted cultivars of alfalfa will be utilized (Matheson *et al.*, 1989).

References:

MacLean, N.L. and J. Nowak. 1989. Plantlet regeneration from red clover hypocotyl and petiole callus. Annals of Botany (submitted).

Mathewson, S. L., J. Nowak and N.L. MacLean 1989. *In vitro* selection of regenerative gentypes from early productive cultivars of alfalfa. Euphytica (in press).

TITLE: Poultry Ventilation

LEADER: D. Allen

OBJECTIVE: To evaluate self balancing and motorized air inlet dampers in a typical small scale poultry building.

PROGRESS:

A self balancing air inlet was constructed and installed in a broiler room for poultry II. It is functioning but less than satisfactory because of the "looseness" of the room and the action of the heat exchanger which doubles as an intake. More refinement will be done in 1989.

The second system was installed in the caged layer room of poultry I. Cable operated slot intake baffles were installed and operated manually using a boat winch. Barber-Coleman controllers and modutrol motor were purchased for installation in 1989.

Work Proposed for 1989:

Broiler room: Performance of self balancing air inlet will be observed and tested. Modifications if necessary will be made.

Caged layer: The air inlet baffles will be motorized. Various modes of motor control will be investigated. These include static pressure control, inlet velocity control and control based on air demand as communicated from, the ventilation microprocessor. The selected options will be tested.

Project 88-125

TITLE: Evaluation of broiler strains.

LEADER: D. C. Crober

OBJECTIVE: To compare the performance, with respect to growth, feed efficiency and carcass quality, of the Marshall and Arbor Acres broiler breeder stocks.

PROGRESS:

The performance of two commercial strains of broiler breeders maintained in cages (and artificially inseminated), and in floor pens (and naturally mated) was compared in a replicated experiment conducted over a complex production cycle. Caged breeders were housed in deep cages measuring 29 x 40.6 cm (8 x 16 inches), one bird per cage. Floor breeders were housed on 2/3 slat and 1/3 litter flooring at 5 birds per m^2. Maximum feed allocation at peak production did not differ significantly between caged and floor-housed breeders of either strain. (Hen-day production for Strain A was: floor 157, caged 156; for Strain M: floor 141, caged 141). Hen-day egg production was significantly different between the two strains in both housing environments. Total hen-day feed consumption of female breeders from 22 to 62 weeks of age was 38.9 kg for caged birds versus 42.5 kg for floor breeders. Progeny from one strain for each parent housing environment were compared. Floor breeder progeny body weight at 3 weeks of age was significantly greater for both males and females. Mortality and feed conversion were not significantly differnt at 3 weeks of age. At 6 weeks of age there were no significant differences among any of the traits measured.

Project 88-126

TITLE: Lambs on Grass and Grain

LEADER: W. G. Mathewson

OBJECTIVE: The objective is to determine whether or not a genotype: environment interaction exists when lambs of different breeds and sexes are grown on grass and on grain.

PROGRESS:

The trial recorded in last year's report was extended in 1988, this time using only wether lambs. The aim once again was to test the hypothesis that when lambs of different breeds are grown on different feeds there is no genotype: environment interaction.

A total of 78 Suffolk and N.C. Cheviot wether lambs from 4 source flocks was assembled at the College during the second week of July and were drenched, sprayed and vaccinated (Clostridia). On July 20 they were weighed on test and assigned randomly within breed to grazing (annual ryegrass) or to hay and grain treatments. Weighing thereafter was at fortnightly intervals, the final weighing off test being on September 14.

Average daily gains over the trial period were 0.25 kg and 0.24 kg respectively for Suffolks and N.C. Cheviots on grain; 0.05 kgs and 0.06 kgs respectively for Sullolks and N.C. Cheviots on grass. Only the treatment (diet) difference was significant.

Project 88-127

TITLE: Effect of Plant Growth Regulators on Fruit Set and Yield of Lowbush Blueberry

LEADER: H.-Y. Ju

OBJECTIVE: To study the effect of plant growth regulators on fruit set and yield of lowbush blueberry

PROGRESS: In field and greenhouse experiments, selected plant growth regulators were applied as a foliar spray at 80% bloom. Prior to bloom, all plots were covered with netted cloth to keep pollinators out. Various concentrations of GA_3 (0, 1, 10, 100 and 1000 ppm) were tested with greenhouse grown 'Brunswick' lowbush blueberry clones. The 100 ppm concentration resulted in the highest yield in terms of % fruit set and number of berries.

The field experiment was designed as a split plot (covered and uncovered with netted cloth) with 5 treatments (GA_3, 100 ppm; Promalin, 2778 ppm; GA_3, 100 ppm + NAA, 0.5 ppm, NAA, 0.5 ppm). This experiment was repeated in greenhouse using two clones ('70-62' and 'Brunswick') for only covered plots. In both field and greenhouse experiments, the combination of GA_3+NAA resulted in the highest yield.

Parthenocarpic fruit formed only on the plants treated with GA_3 under the covered plots in the field experiment. Percent fruit set, number of berries was higher ($p=0.05$) within the uncovered plots than under the covered plots in the field condition. Number of berries was significantly higher ($p=0.05$) in 'Brunswick' clones than '70-62' clones. The NAA treatment resulted in abnormal conical shaped berries.

TITLE: Mycoherbicides

LEADER: M. G. Sampson

OBJECTIVE:

1. To investigate the potential of pathogens isolated from coltsfoot (Tussilago farfara), wild buckwheat (Polygonum convolvulus) and hemp nettle (Galeopsis tetrahit).

2. To conduct general screening of various weeds for pathogens that may have potential as mycoherbicides in the weeds studied.

3. To screen several pathogens for production of phytotoxic toxins that could have potential in weed control.

PROGRESS:

A total of 42 organisms have been isolated from various fungi from weeds. These weeds include hemp nettle, poison ivy, wild buckwheat, quackgrass, wild production. Two organisms from quackgrass and one from colts foot have been shown to produce toxins that have phytotoxic effects. These effects appear to be broad spectrum. Several other organisms may also have the potential to produce toxins.

Pathogenicity studies continued with organisms isolated from colts foot, quackgrass and wild buckwheat. Media studies have been conducted and the optimum media as well as the optimum pH for spore production have been identified.

Project 88-129

TITLE: The Effect of Dietary Omega-3 Fatty Acids in Laying Hens

LEADER: A. R. Robinson

OBJECTIVE:

1. To feed laying hens supplemental omega-3 fatty acids in the form of memhaden oil.

2. To determine the influence of those dietary omega-3 fatty acids on blood lipid composition, cholesterol levels and cholesterol concentration in eggs of laying hens.

3. To determine if omega-3 fatty acids are incorporated into eggs when added to the feed in the form of memhaden oil.

PROGRESS:

The identification and quantitation of the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in underivatized forms by High Pressure Liquid Chromatography (HPLC) was attempted. The HPLC system utilized a C_{18} ODS reverse phase column with a mobile phase of methanol:water (70:30) with a flow rate of 1.0 ml/min and a UV detector set at 254 nm. The system as described failed to yield any separation. Accordingly, the mobile phase was changed to a relatively non-polar system consisting of hexane:isopropyl alcohol (99.9:0.1>% v/v). This solvent system was not acceptable since it underwent degassing after passing through the column and prior degassing of the hexane with helium failed to correct the problem. Our results indicate that it is most probably essential to derivatize the fatty acids prior to HPLC analysis.

Analysis of the omega-3 fatty acids by gas liquid chromatography was partially successful; however the present column is not capable of separating a large mixture of fatty acids such as one would encounter in a biological sample.

Accordingly, a silar 5 CP 30 meter capillary column will be purchased and used for the separation of the omega-3 fatty acids in the various tissues from hens fed supplemental omega-3 fatty acids.

TITLE: Herring For Growing Mink

LEADER: M. L. Connor & D. M. Anderson

OBJECTIVE: To determine the feasibility of using herring in the diet of growing mink.

PROGRESS:

Background:

Many mink ranchers make their own wet feeds. It is important for them to be able to take advantage of opportunistic feeds which may be readily available for a reasonable price at specific times during the year. Herring fits this category for many Nova Scotia ranchers from mid-August through September. This time period is also one when the young mink are growing rapidly and nearing maximum feed consumption.

Herring however poses at least two problems for mink ranchers.

1. The abundance during a short season means that full advantage of surpluses can only be made if adequate freezer space is available.
2. Herring contains a thiaminase which destroy thiamine and can lead to vitamin deficiency problems.

These two draw backs are not insurmountable and investigations to counter these could be a great bonus for the mink industry. The storage problem may be minimized by using herring meal, which contains 75% protein, already available in the region. The thiaminase problem may be countered by (a) addition of sufficient thiamine to eliminate a problem (b) keeping the levels low enough in the diet so it is not a threat and (c) processing eg partial cooking, to inactivate the thiaminase.

The opportunity to use partially cooked herring that is retained frozen may be a viable alternative. Whereas the production of herring meal in standard practice uses high temperatures that can reduce availability of nutrients and incurs high production costs; the production of the partially cooked wet product should not reduce nutrient availability and should be processed at reduced cost. This may result in a reduced cost of the product on a useable nutrient basis. In addition, the oil retained in the partially coocked product may contribute significantly to meeting the needs of the growing mink. The high energy (fat) has been reduced/removed in the herring meal production.

Progress: Results of the 1988-89 trial are not yet completed. From the data to date the weight gain by male mink fed dry diets appear to be better than wet diets although the opposite is true for the females. The final body weights appears to reflect the weight of pelt. Length of pelt appears constant across the

treatments. Pelt quality and economic returns are not yet available on this group of animals.

	National Pellets		15% Herring Meal		15% Herring Product	
	Males	Females	Males	Females	Males	Females
weight gain (g)	1033	347	1008	447	1015	520
feed consumption dry matter (kg)	12.74	7.92	13.84	10.61	14.68	10.31
final body wt.(kg)	2.163	1.028	1.979	1.063	1.858	1.015
pelt weight (g)	136	62	128	64	115	61
pelt length (cm)	73.1	58.9	73.5	59.1	70.6	57.6

Blood samples have been collected on the animals prior to harvesting. These samples need to be analyzed for Trans ketolase activity which is a measure of thiamin status of the mink. The technique set up and completion requires 8 weeks of work.

Project 88-131

TITLE: Crab Meal in Layer Hen Diets

LEADER: D. M. Anderson

OBJECTIVE: To evaluate the use of crab meal in diets for layer hens housed in different environments.

To investigate the interaction of temperature on diet type in laying hens.

PROGRESS:

The performance of commercial laying hens (DeKalb Leghorns) was compared over a 13 28-day period laying cycle. The crab meal, a by-product of commercial crab meal industry in Atlantic Canada, contained 0.88% sodium, 1.5% chlorine, 1825 kcal/kg of metabolizable energy (M.E.), 32.1% crude protein, 12.9% calcium and 1.64% phosphorus. All diets were formulated to contain 15.0% crude protein, 2900 kcal/kg of M.E., 3.4% calcium and 0.32% available phosphorus. Control of environmental temperature was limited to maintaining the prescribed average temperature over a 24-hour period by the addition of heat, as necessary. Cooling was not available, so daily average temperatures were frequently in excess of target during the warmer months. Difference in total hen-day egg production among dietary treatments. In general, egg specific gravity improved with increased level of crab meal in the diet, at all temperatures. Differences in egg weight and Haugh Unit Score among both dietary and temperature treatments showed no apparent trend. At all temperatures, total feed consumption increased with increasing level of dietary crab meal. For most dietary treatments, feed consumption was greatest at 18 C. Body weight gain over the first half of the production cycle was reduced for the 8% and 12% crab meal treatments. However, compensatory gains made differences among dietary treatments in final body weight very slight and non-significant. No trends were apparent among differences in body weight between environmental temperatures at any stage of the production cycle. Overall feed efficiency decreased with increasing crab meal level. Temperature effect on feed efficiency were inconclusive. Mortality losses in this experiment were minimal, and were not treatment-related.

Project 88-132

TITLE: Safe Use of One-Tonne Fertilizer Bags

LEADER: Finbar Desir

OBJECTIVE:

1. To investigate various methods of providing safety in the use of one-tonne fertilizer bags;

2. To recommend a safe method of using one-tonne fertilizer bags. This method should also be simple, convenient, and relatively inexpensive.

PROGRESS: For a few years now fertilizer has been available in one-tonne bags as well as in standard bag sizes. This has proven to be very advantageous for many farmers, who find it more convenient to fill their spreaders from one large container than to be handling many heavy smaller bags. The one tonne bag is normally supported on a front end loader, which raises it over the spreader. The farmer then manually operates a chute at the bottom of the bag to fill the spreader.

To operate the chute, the farmer must stand below the bag. This places him in danger of serious injury if the hydraulic system of the front end loader were to fail. Hydraulic units such as pilot-operated flow control valve and hose break valves are available for protecting the load from accidental damage. However, present American Society of Agricultural Engineering (ASAE) standards do not permit anyone to stand or work under a loader or any other hydraulic unit, unless it has been securely blocked.

INVESTIGATION

The following systems were investigated:

a. Hose break valves
b. Pilot-operated valves
c. Remote chute operating system
d. Mechanical cylinder locks
e. Tonne-bag wagon

a. <u>Hose Break Values</u>

Hose break valves are used in industrial loader and backhoe hydraulic systems to prevent collapse in the event of hose breakage. If, for example, a hose were to break while the loader bucket was raised, the hose break valve would prevent the bucket from dropping to the ground.

The valve is a small unit about 7.5 cm (3 in) long fitted into one port of each hydraulic cylinder in the system. It allows

normal oil flow in either direction, but closes if oil begins to rush out of the cylinder. At about $50 a valve, it is the simplest and least expensive method of adding a measure of safety to any hydraulic system. Its disadvantages are that it tends to slow down the rate of normal operations, and when it engages, it does so with great force which puts a strain on the tractor. This is because there is a slight lag between hose breakage and valve engagement during which the bucket begins to drop. The valve stops this movement suddenly, putting a strain on the tractor.

b. Pilot-operated Valves

The disadvantages of the hose break valve are overcome by the pilot-operated valve. This valve also shuts fully in the event of hose breakage, but it is more sensitive and smoother in its operation. It does not interfere with normal operation of the system, and it engages without jarring the system. However, it is much more expensive, requiring modification of each cylinder on which it is installed.

The pilot-operated valve is the safety system used to protect linesmen and other maintenance personnel of the power and telephone companies. It is considered adequate for protection of life in the high-risk application of hydraulics in which men are raised 12 meters and more off the ground.

The agricultural industry, however, follows the standards set by the A.S.A.E., which prohibit dependence on all but mechanical blocking safety devices for protection of life. This precludes the use of hose break valves or pilot-operated valves for making one-tonne fertilizer bags safe.

c. Remote Chute Operating System

In order to keep the farmer away from the one-tonne bag during operation, a remote chute operating system was considered. The system would consist of an opening and closing mechanism attached to the chute at the bottom of the bag, a light frame to support the mechanism, a control lever to the chute mechanism. From the tractor seat, the farmer could then open and close the bag chute to fill his spreader.

This system was not supported for two reasons:

1. Attachment of the chute mechanism still required the farmer to be under the bag. Also, the fertilizer is contained in a plastic liner in the one-tonne bag, and the liner must be cut inside the chute when the bag is firt opened. This also requires the farmer to be under the bag. These operations could be done with the bag lying on its side, but considerably more time was required.

2. Farmers complained about the inconvenience and time involved

in fitting the frame and the chute mechanism to each bag as it was brought into service. Such a system was considered undesirable for farmers who had several tonnes of fertilizer to spread in limited time.

d. Mechanical Cyliner Locks

The suitability of mechanical cylinder locks was investigated. The locks consist of long U-shaped brackets that are placed around the extended cylinder rods, preventing the cylinders from retracting, even if a hose were to break. They must be manually installed when the cylinder is extended, and manually removed before the cylinder can be retracted.

It was decided to design a semi-automatic, multi-level mechanical stop which would automatically lock into place whenever the cylinder was extended, irrespective of the length of extension. The locks would be manually disengaged for cylinder retraction.

Certain makes of cylinders, particularly those on John Deere loaders, are not designed for mechanical locks. Their end plates could be punched in by such devices, with disastrous results.

In discussions with the major tractor manufacturing companies (John Deere Ltd., Case-IH, Ford, New Holland), they all expressed concern about the use of their tractors and loaders in handling one-tonne fertilizer bags. These bags are used only in Atlantic Canada. Because of the risk involved to operators, and the problems of liability, there was little support for any system that would encourage use of front end loaders for one-tonne fertilizer bags.

Without the support of the manufacturers, it was considered inadvisable to promote a system based on front end loaders or other hydraulic systems.

e. Tonne-bag Wagon

A satisfactory system for handling one-tonne fertilizer bags is the tonne-bag wagon developed and used by Mr. John Waalderbos of Shinimicas, Cumberland County.

The tonne-bag wagon consists of a steel superstructure built on any flat farm wagon of 5-tonne or larger capacity. The structure supports an I-beam at a height of 4 m (13 ft) above the ground. The I-beam projects 1 m beyond the wagon. A block and tackle running along the I-beam picks up one-tonne bags from the wagon, and carries them to the overhang for filling a spreader. The farmer still has to stand under the bag to operate the chute. However, supporting the bag on a block and tackle eliminates risks associated with hydraulic systems, and reduces the danger to the operator. For additional safety, the bag is attached to the block and tackle through a 4-hook frame rather than chains, which tend to wear down and fray the bag loops.

In addition to safety, this system has the following advantages: - Several one-tonne bags of fertilizer can be loaded onto the wagon for taking to the field. This eliminates the waste of time and fuel expended in trips from the field to the farmstead for filling the spreader. - Only one tractor and one operator are required for fertilizing. In systems using front end loaders or other hydraulic systems, two tractors are required.

CONCLUSION

Of the systems investigated, the tonne-bag wagon is the one recommended for increasing operator safety in the use of one-tonne fertilizer bags. Hydraulic safety devices such as the hose break valve and the pilot-operated valve are not sanctioned by A.S.A.E. standards. The remote chute operating system proved unsatisfactory. Mechanical cylinder locks can have disastrous results on some cylinders. The major farm tractor manufacturers do not support the use of their front end loader for handling one-tonne fertilizer bags.

The tonne-bag wagon provides a higher degree of safety than any of the other methods. It has additional advantages in that it can carry several bags of fertilizer to the field, and it eliminates the need for a second tractor. It is also simple and convenient to use. The cost will vary from one farm to the next depending on the availability of a farm wagon and steel, and the ability of the farmer to build his own unit.

ACKNOWLEDGEMENT

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TITLE: A management system for N.S.A.C. entomological collections

LEADER: Dr. Jean-Pierre R. Le Blanc

OBJECTIVES: To preserve, classify and catalogue arthropods (arachnids, insects, mites, ticks) and nematodes for use in agricultural reference and research collections.

PROGRESS:

This modest but timely one-year grant allowed us to complete the computerization of our entomological collections. The computerization of both our dry and wet collections has resulted in an excellent research and management tool. It enables the Curator to readily identify strengths and weaknesses and, therefore, to appropriately guide future collecting endeavours. In addition, a more efficient assistance can now be provided to our various user groups as computer queries are much faster than manual searches.

As it stands now, the dry collection comprises of over 12,000 computer records, each covering 39 different fields of information. The wet collection is only a nucleus. At present, it comprises of ca, 500 computer records. For both collections, we have hard copies available to view in the museum and these represent updated catalogues. Our methodology and computer programmes were made available to the A.E. Roland Herbarium.

As we have now incorporated the back-log information into the new systems, our future plans are to computerize the loan and exchange activities of the Museum. We would also ask of any researchers to be so kind as to send us voucher specimens of arthropods and nematodes they may encounter in their research programme. In the near future we plan to extend this invitation to all of the Atlantic region and then nationally as well. For any information related to the procedure of donating entomological specimens to the Museum, please do not hesitate to contact the Curator and/or his assistant at the address below. If you send specimens directly, please indicate the following: location and date of collection, name of the collectors, and host plant and/or habitat.

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TITLE: Swine conformation and relation to carcass composition

LEADER: D. L. Patterson

OBJECTIVE:

- to evaluate a microcomputer based image processing system as a tool in predicting carcass composition of swine
- to use body conformation at several ages to predict swine carcass conformation in a more objective and quantifiable manner than has been possible to date.

PROGRESS:

Background: Prediction of lean yield of the swine carcass from live animal measurements avoids having to resort to progeny or sib testing in selection of animals for carcass traits. Ultrasonic backfat thickness is commonly used to predict carcass yield, however at weights less than 80 kg the technique has a low accuracy (Sather et al, 1987). If selection can be carried out at earlier ages then selection intensity can be increased (Kanis, 1985). Visual assessment of animals, although subjective, is likely to remain important in such selection. Digital image analysis techniques, widely used in biomedical applications, offer an opportunity to make more objective measurements of live animal and carcass shapes. Although little used to date in animal agriculture, studies show potential applications in dairy conformation studies (Patterson, unpublished data) and in beef(Greenough, 1987, personal communication).

Progress to Date:

A. A preliminary study on eight Yorkshire pigs of three to four months of age was carried out to determine accuracies of measurements. Each pig was measured twice for body length, height, width and heartgirth, and videotaped from a variety of angles as it moved about the pen. Measurements were taken off the videotapes using the Bioquant Image Analysis System TM, with at least two frames per animal measured and each measurement taken twice per frame. The repeatability of measurements taken on the actual animal varied from 70% for length of pig to 92% for height at ham. Repeatabilities of measurements taken off the same frame of the videotape ranged from 84% for chest depth to 99% for height at shoulder. However, repeatabilities of measurements taken off two separate frames were lower (60 to 68%). Correlations between live and videotape measurements were lower than desirable (0.36 to 0.46), although mean values of the two types of measurements were comparable.

B. A second trial involved restraining the pigs in a small enclosure while they were videotaped. Repeatabilities of live animal measurements were similar to those found in the first trial, and repeatabilities of video measurements were 90% to 99%. Although some correlations between actual and video measurements were low, others (chest depth, middle depth) were in the 0.8 to 0.95 range. The small number of pigs involved in these trials does not allow for accurate estimation of correlations, but the trials were useful in establishing protocols of measurement. Following these, a specialized measuring device was constructed.

TITLE: Buoyancy Separation of Forage Particles and Their Use as a Concentrate Feedstuff

LEADER: A. Lirette

OBJECTIVE: Production of highly digestible protein and energy concentrates with forages as original material should be investigated. Recent experiments on buoyancy of different particle sources indicated that a relationship exists between nutritive value and buoyancy of feed particles in liquid (A. Lirette, Ph.D. Thesis 1987). The objectives of this present study are divided in phases representing 3 research years:

1st year: Improvement of the actual buoyancy technique and investigation of particle buoyancy properties of many different forage species including those most common to Atlantic Canada to find the best variety for isolation of the concentrates.

2nd year: Investigate the digestibility of the protein/energy concentrate particles with nylon bag technique in fistulated ruminants. Rats will be used as monogastric model to investigate the utilization of concentrate particles by domestic single stomach species. Analysis of the a.a. content of these concentrates will be necessary.

3rd year: Industrial applications. Isolate a larger quantity of concentrate particles and undertake experiments on digestibility and growth rate in ruminants, swine and poultry when fed with these particles.

PROGRESS:

The interrelationship between buoyancy, and that of the nutritive and physical composition of various forages was studied. Buoyancy trials were performed using samples of ground forages placed on the waters surface in a glass cylinder filled with 4 L of water. The cylinder was emptied from the bottom with every 400 ml stratification being collected separately and dried. Buoyancy curves were constructed. Chemical analysis was performed and the shape and dimensions of the samples were measured by use of the microscope. The particles which were least buoyant were long, very fibrous with a cuboid shape and had a low percentage of crude protein and a high ADF percentage; thus contained a high proportion of lignin. The particles with the greater buoyancy were relatively shorter, thinner, contoured and contained a high percentage of crude protein and a low percentage of ADF. The particles were used in an animal experiment involving the feeding of three groups of five mice three different diets. Diet 1 was a standard mouse ration, diet 2 was 95% normal ration plus 5% high protein/low fiber particles, and diet 3 contained 95% normal ration plus 5% high fiber/low protein particles. The 15 mice were fed and housed individually for 10 days. Measurements of weight

gain, feed consumption, feed to gain, and cholesterol were taken over this period. Statistical analysis was performed on these parameters using ANOVA and the Student Neuman Keuls test. The mice on diet 2 had the highest mean wt. gain of 2.21g while mice on diet 1 and 3 gained 1.52g and 1.36g respectively. Mice on diet 1 had a mean cholesterol level of 314.51 mg/dL while those of diet 2 and 3 had levels of 267.45 mg/dL and 302.78 mg/dL respectively. The mice on diet 3 had the highest feed/gain ration while diet 2 resulted in the lowest ratio. Statistical analysis for wt. gain, cholesterol level, and feed/gain did not show any significant difference in respect to the diets fed. This was most likely due to the large variation between the animals themselves. Feed consumption however was found to be very significant; with diet 2 giving the highest mean value of 64.25g and those on diet 1 had the lowest mean consumption of 48.91g.

FUNDING: NSERC